



BETHLEHEM STRUCTURAL SHAPES

Bulletin No. 13

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NEW YORK, U. S. A.



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BETHLEHEM STRUCTURAL SHAPES

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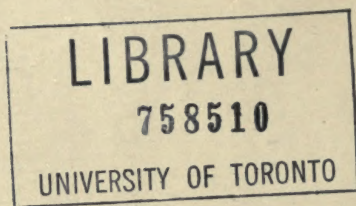
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BETHLEHEM STRUCTURAL SHAPES

Bethlehem Structural Shapes have proven to be a radical improvement and advance in the field of structural steel, reducing the cost and extending the use of steel in construction. They have achieved a remarkable success and are highly regarded and strongly endorsed by leading engineers and architects.

Bethlehem Structural Shapes are wide flange I-Beam Sections rolled by the Grey Universal Beam Mill. Similar beams, 10 to 30 inches deep, with flanges 10 to 12 inches wide, have been rolled by the Grey Mill in Germany since 1902 and are used extensively in Europe, England, Canada, and elsewhere. The larger and improved Grey Mills at Bethlehem, placed in successful operation early in 1903, rendered such sections available for the first time in this country.

In regard to shape and strength, Bethlehem Sections afford many advantages. They can be used for every purpose instead of ordinary beams, or even instead of riveted sections, with economy in weight or saving in cost of fabrication, and in most cases with a saving both in weight and in cost of fabrication.

The Grey Mill has vertical as well as horizontal rolls, forming the web and flanges of a beam by coincident rolling operations. Wider flanges are thus obtained than can be made by former methods of rolling. The method of rolling is shown by Fig. 1. The horizontal rolls, *H*, and the vertical rolls, *V*, are brought proportionately closer together at each successive passage of the beam through the rolls. Fig. 2 represents a supplementary mill through which the beam passes, the purpose of which is to edge the flanges only, no other work being done in this secondary mill.

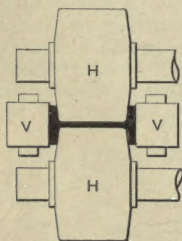


Fig. 1

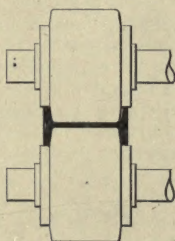


Fig. 2

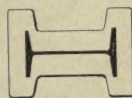


Fig. 3

For large beams the ingot is cast approximately of an I-beam shape, as shown by Fig. 3, in which the outer line represents the cross-section of the ingot in relation to the finished beam, both being drawn to scale. By successive reductions the ingot is rolled into a beam of proportionate dimensions.

Shapes produced by the Grey Mill have thus a uniform work of reduction in the rolling on all parts of the section and a uniform quality of metal throughout the section with a consequent absence of internal stress.

In the following table this uniformity of quality is illustrated by results taken at random from numerous tests of Bethlehem sections:

Location of Test Piece	Ultimate Strength, Pounds per Square Inch	Elastic Limit, Pounds per Square Inch	Elongation in 8 Inches	Reduction of Area
30-inch I-Beam:				
Web . . .	66,550	39,960	25.6%	50.6%
Flange . .	63,190	37,200	26.2	51.5
Root . . .	64,480	38,880	26.3	49.8
14-inch H-Column:				
Web . . .	63,670	35,590	32.5%	55.2%
Flange . .	61,740	38,180	31.2	59.9
Root . . .	63,520	37,900	28.2	54.6

Heretofore the largest beam rolled in this country has been 24 inches deep, weighing 115 pounds per foot and having a section modulus of 246. Whenever greater strength was required a riveted girder was necessary. Bethlehem beams range to a maximum size of 30 inches deep, weighing 200 pounds per foot and having a section modulus of 610, or nearly two and one-half times the strength of the largest beam previously rolled. The opportunity for using rolled beams instead of built-up riveted girders is, therefore, greatly increased.

Bethlehem rolled beam and girder sections can be advantageously used as girders for buildings, crane runways, short span bridges, track stringers, and for many other purposes where the more expensive type of riveted girder has heretofore been necessary. These rolled beams and rolled girders afford a saving in weight of metal and also a large economy in cost of fabrication, as they do not require the punching, assembling and riveting necessary for building a riveted girder. Moreover, the rolled beams can be obtained promptly as contrasted with the delay always experienced in procuring riveted girders.

Wide flanges give increased lateral stiffness, which commends the use of such beams in many cases, particularly as girders for bridge floors, where the wide flanges afford ample bearing surface and rigidity.

Three separate types of shapes are furnished: Bethlehem I-Beams, Girder Beams, and H-Column Sections.

BETHLEHEM I-BEAMS

Bethlehem I-Beams from 8 inches to 24 inches in depth, inclusive, have the same strength or section modulus and coefficient of strength as Standard Beams of the same depth. Bethlehem Beams, due to the scientific proportions of the sections, weigh generally 10 per cent less than Standard Beams of the same depth and strength. For example, a Bethlehem 15-inch I-Beam, weighing 54 pounds per foot, has a coefficient of strength of 867,000. The corresponding Standard Section is a 15-inch I-Beam weighing 60 pounds per foot, having a coefficient of strength of 866,100. Therefore for equal strength the Bethlehem Beam weighs 6 pounds per foot less than the Standard Beam, a saving of 10 per cent in weight.

Similar comparisons with other sizes of the Standard Beams previously rolled by the mills of this country will show that the Bethlehem I-Beams afford an equal carrying capacity but with practically 10 per cent less weight of metal.

The tables of "Comparison of Bethlehem I-Beams with Standard I-Beams," on pages 37 and 49, show the relation between the two types of beams for all sizes.

BETHLEHEM GIRDER BEAMS

Bethlehem Girder Beams from 8 inches to 24 inches in depth, inclusive, have a strength or section modulus and coefficient of strength equal to that of two minimum weight Standard I-Beams of the same depth. The girder beam, however, weighs generally $12\frac{1}{2}$ per cent less than the combined weight of the two Standard Beams, not considering the saving in weight of separators needed for assembling the Standard Beams into a girder. For example, a Bethlehem 15-inch Girder Beam, weighing 73 pounds per foot, has a coefficient of strength of 1,256,000. Two Standard 15-inch I-Beams, each weighing 42 pounds per foot, have a total coefficient of strength of 1,256,600. Thus, for equal depth and coefficient of strength, the girder beam weighs 11 pounds per foot less than the two Standard Beams. This is a saving of 13 per cent in weight, not including separators, which would add at least $2\frac{1}{2}$ pounds per foot more to the weight of the assembled girder. In this case a total saving of 16 per cent in weight is afforded by the Bethlehem Girder Beams, besides the saving in the cost of assembling the Standard Beams into a girder.

The tables of "Comparison of Bethlehem Girder Beams with Girders of Standard Beams," on pages 36 and 48, show the relation between the two types of beams.

The tables on pages 36-37 and 48-49 furnish a key for the comparison of Bethlehem I-Beams and Girder Beams with Standard Beams. A framing plan for Standard Beam shapes may be easily revised for the use of Bethlehem Beam Sections. In general, no rearrangement of the plan will be necessary and no recalculation will be required, except to select the proper Bethlehem Sections which are equivalent in strength to the Standard Beams and Girders.

BETHLEHEM ROLLED H-COLUMNS

All column shapes having the same section number are made by the same rolls. Thus, the 14-inch H-Columns, comprising all the weights and variations in size of sections shown on pages 52-53 and 60-61 are from the same rolls, furnishing a series of rolled columns of similar shape. Columns can thus be selected of the proper areas to suit variations of load, affording a wide range of sizes from the same rolling and insuring prompt delivery.

To provide for splices and connections is the only fabrication required for these rolled columns. In the case of columns with thick metal the holes require drilling, which can be done economically with a multiple drill. The saving in cost of fabricating the rolled column as compared with a built-up riveted column is a great advantage in favor of the solid rolled shape. Sections can be spliced to make a practically continuous column, and connections are easily made in the most approved manner of the best structural practice. All surfaces of the column are accessible for painting.

All Bethlehem sections are of open hearth steel exclusively, conforming to Manufacturers' Standard Specifications and also to American Railway Engineering and Maintenance of Way Association Specifications. Material complying with any other standard specifications may be furnished by special arrangement. Large ingots, up to 10 tons in weight, are used, so that the work of reduction in rolling the shapes is sufficient to develop proper ductility of metal.

EXPLANATORY NOTES

The flanges of Bethlehem I-Beams and Girder Beams have a uniform slope of 9 per cent. The flanges of the H-Column Sections have a uniform slope of 2 per cent.

Bethlehem I-Beams and Girder Beams are increased, as shown in Fig. 1, by spreading the main rolls, which adds an equal amount to the thickness of the web and to the width of the flanges, all other dimensions remaining unchanged.

H-Column Sections are increased, as shown in Fig. 2, by spreading both sets of rolls; the thickness of the web and the width of the flanges are increased equally, the thickness of the flanges being increased a proportionate amount.

Weights tabulated for Bethlehem I-Beams provide sufficient variations for ordinary purposes. Only the minimum weights are tabulated for the Girder Beams. Intermediate or heavier weights, corresponding to the usual variations of Standard Beams, may be furnished by special arrangement. The H-Column sections are rolled only to the weights given in the tables.

The sections are numbered throughout the tables for convenience in identification and ordering.

Shapes will be cut to ordered length within an allowable variation either way, as follows: Bethlehem I-Beams from 8 inches to 24 inches inclusive, within $\frac{3}{8}$ inch; all other sections, within $\frac{1}{2}$ inch. For cutting with less variation, or to exact length, an extra price is charged.

Sections are rolled to catalog weight but may have an allowable variation of $2\frac{1}{2}$ per cent from nominal section.

Fig. 1

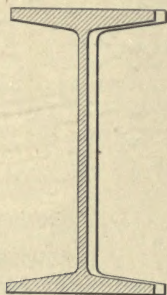
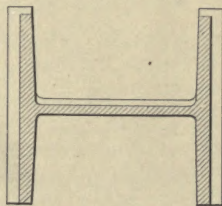


Fig. 2



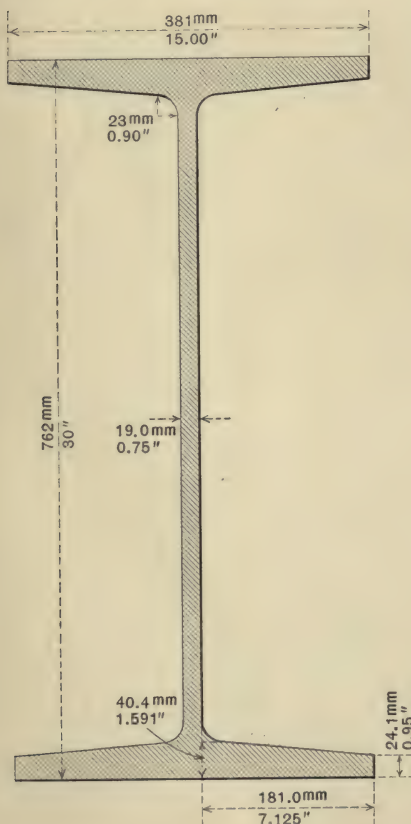
NOTE.—The weights shown in connection with the cuts on pages 7 to 23 inclusive are given in pounds per lineal foot and kilograms per lineal meter.

BETHLEHEM ROLLED GIRDER BEAMS

G-30-a

200 Pounds

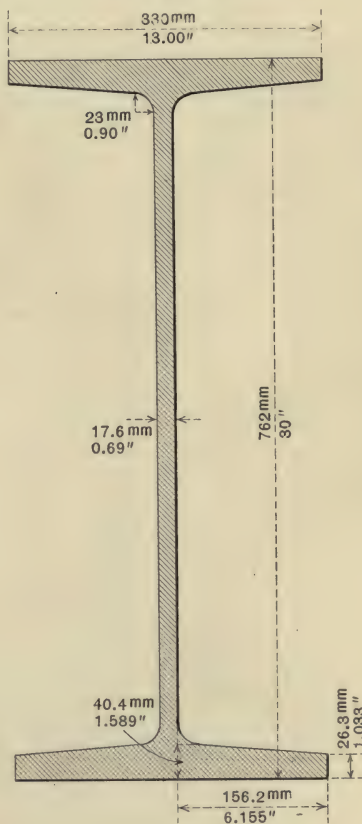
297.6 Kilograms

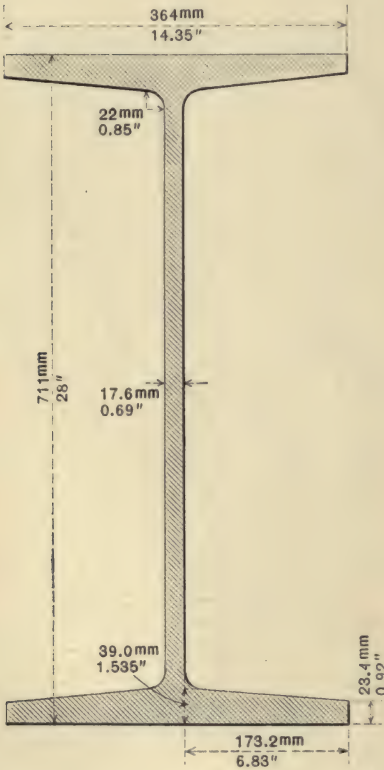
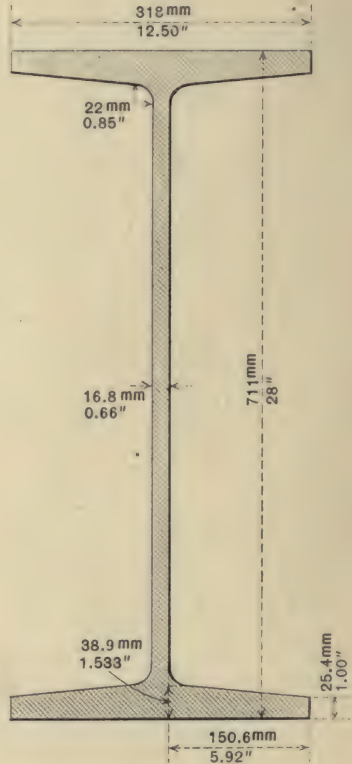


G-30

180 Pounds

267.9 Kilograms



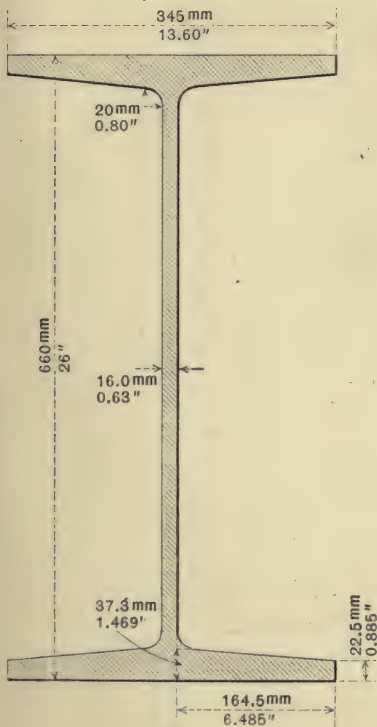
BETHLEHEM ROLLED GIRDER BEAMS**G-28-a****180 Pounds****267.9 Kilograms****(NOT ROLLED AT PRESENT)****G-28****165 Pounds****245.6 Kilograms**

BETHLEHEM ROLLED GIRDER BEAMS

G-26-a

160 Pounds

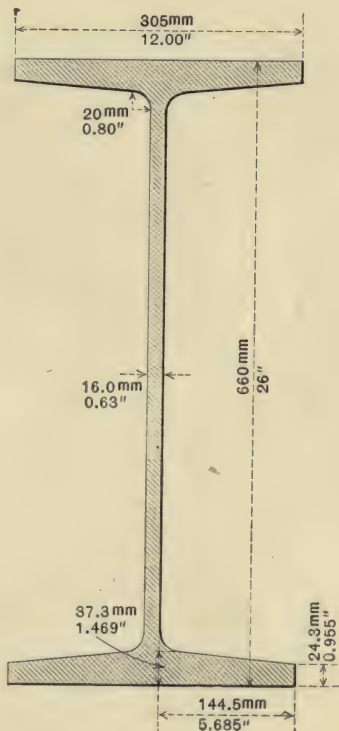
238.1 Kilograms

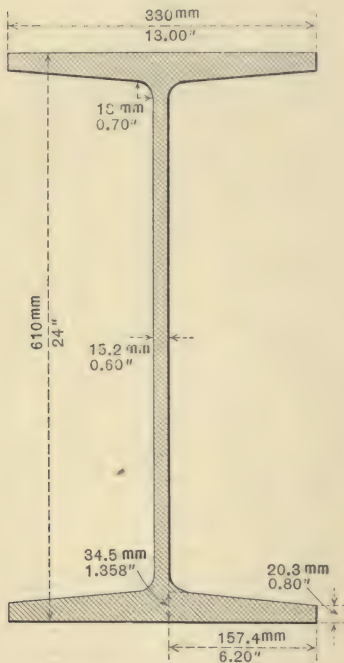
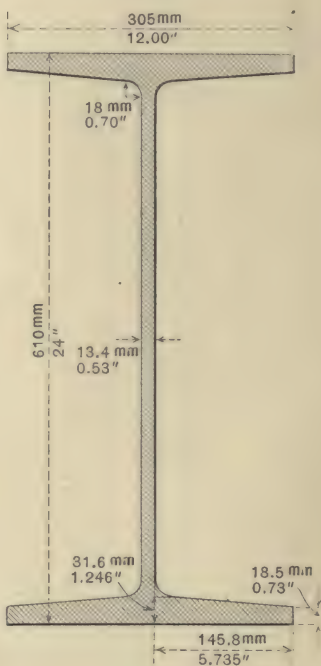


G-26

150 Pounds

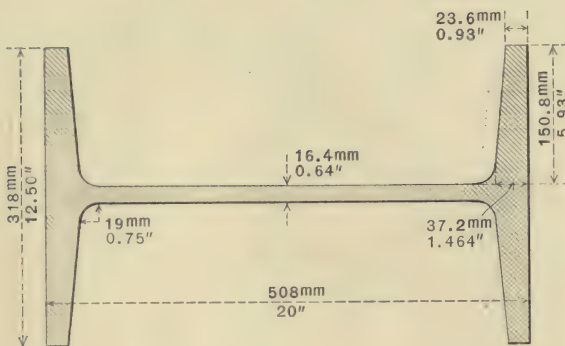
223.2 Kilograms



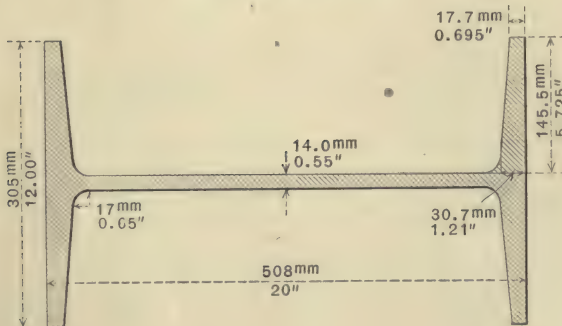
BETHLEHEM ROLLED GIRDER BEAMS**G-24-a****140 Pounds****208.3 Kilograms****G-24****120 Pounds****178.6 Kilograms**

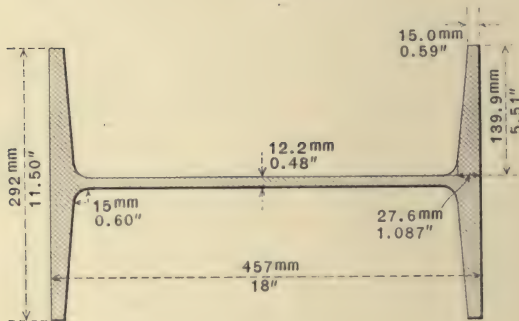
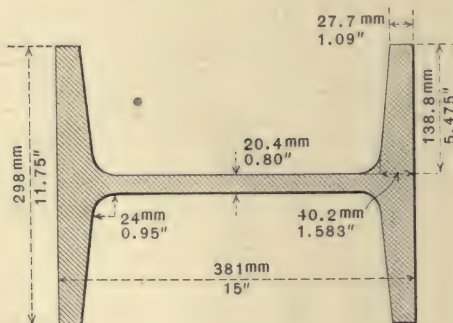
BETHLEHEM ROLLED GIRDER BEAMS

G-20-a
140 Pounds
208.3 Kilograms

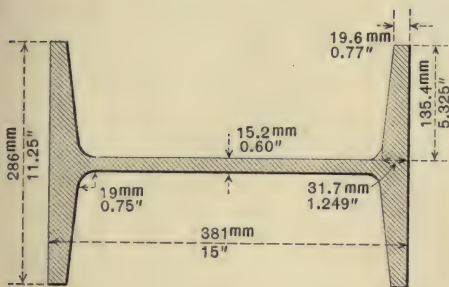


G-20
112 Pounds
166.7 Kilograms



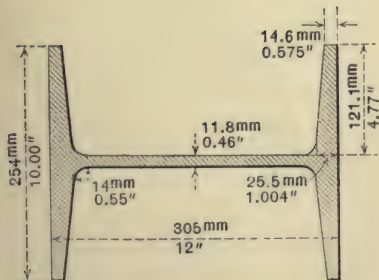
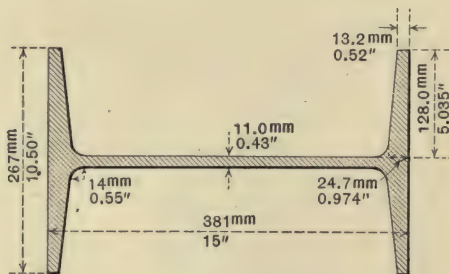
BETHLEHEM ROLLED GIRDER BEAMS**G-18****92 Pounds****136.9 Kilograms****G-15-b****140 Pounds****208.3 Kilograms**

BETHLEHEM ROLLED GIRDER BEAMS



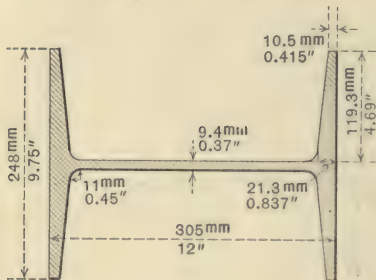
G-15-a
104 Pounds
154.8 Kilograms

G-15
73 Pounds
108.6 Kilograms



G-12-a
70 Pounds
104.2 Kilograms

BETHLEHEM ROLLED GIRDER BEAMS

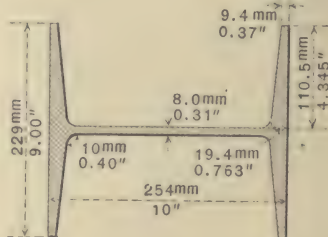


G-12

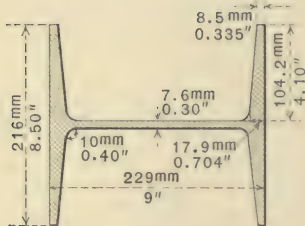
55 Pounds

81.9 Kilograms

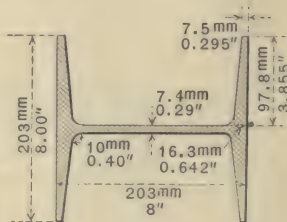
G-10
44 Pounds
65.5 Kilograms



G-9
38 Pounds
56.6 Kilograms



G-8
32.5 Pounds
48.4 Kilograms

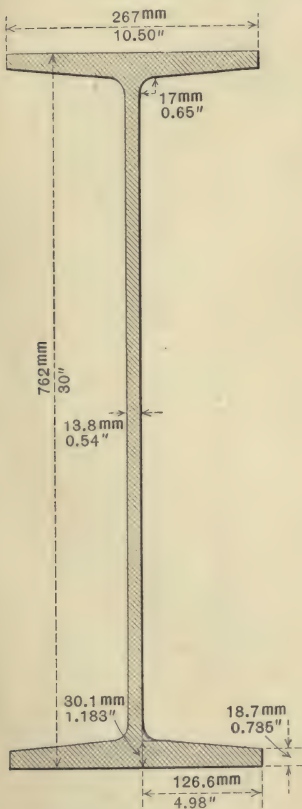


BETHLEHEM I-BEAMS

B-30

120 Pounds

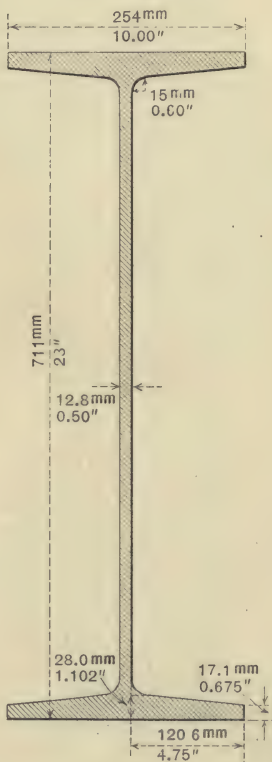
178.6 Kilograms



B-28

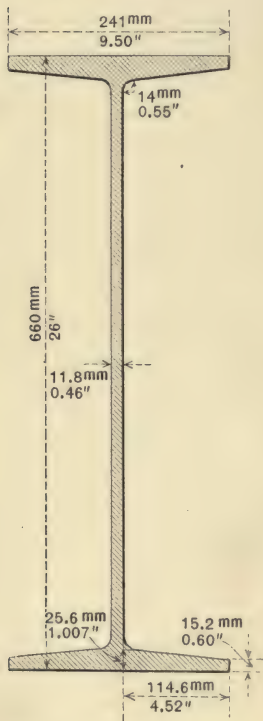
105 Pounds

156.3 Kilograms

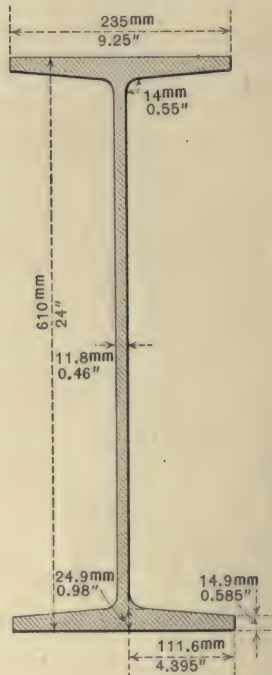


BETHLEHEM I-BEAMS

B-26
90 Pounds
133.9 Kilograms



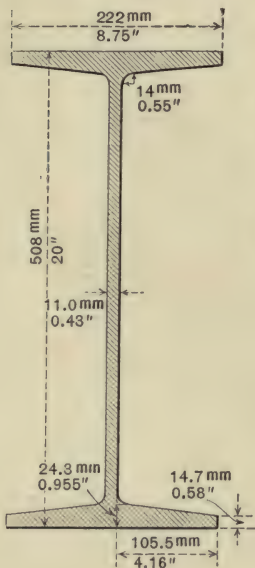
B-24-a
84 Pounds
125 Kilograms



BETHLEHEM I-BEAMS

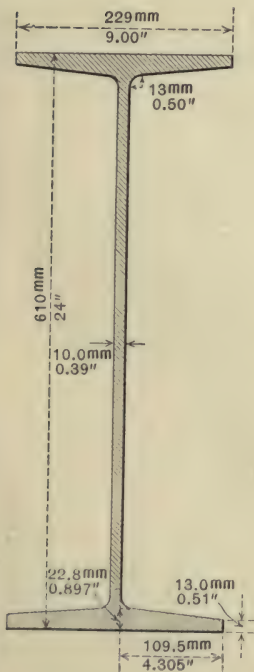
B-20-a

72 and 82 Pounds
107.2 and 122 Kilograms



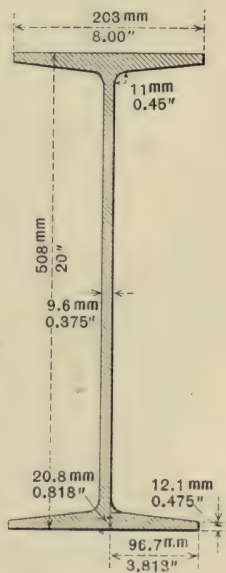
B-24

73 and 83 Pounds
108.6 and 123.5 Kilograms

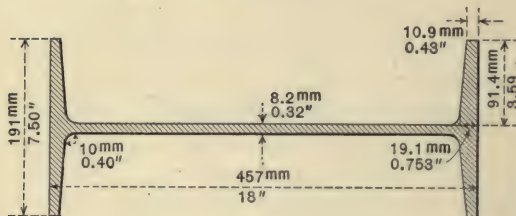


B-20

59, 64, and 69 Pounds
87.8, 95.2, and 102.7 Kilograms



BETHLEHEM I-BEAMS

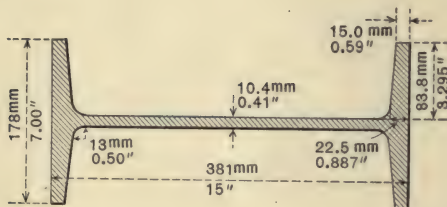
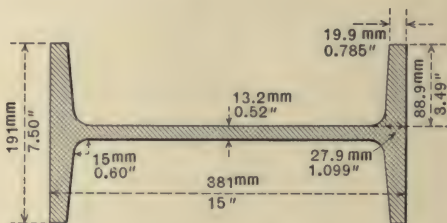


B-18

48.5, 52, 54, and
59 Pounds

72.2, 77.4, 80.4, and
87.8 Kilograms

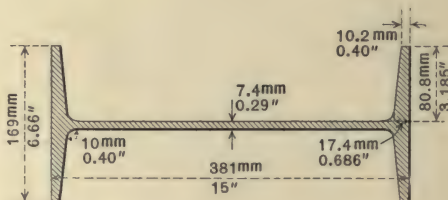
B-15-b 71 Pounds 105.7 Kilograms



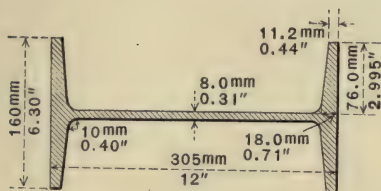
B-15-a

54 and 64 Pounds
80.4 and 95.2 Kilograms

B-15 38, 41, and 46 Pounds 56.6, 61, and 68.5 Kilograms

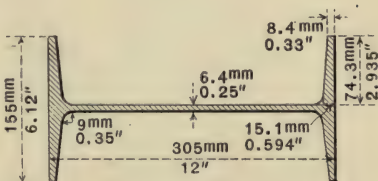


BETHLEHEM I-BEAMS

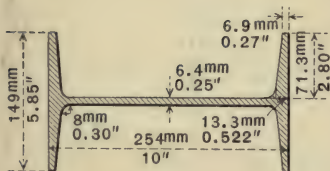


B-12-a
36 Pounds
53.6 Kilograms

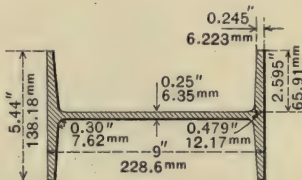
B-12
28.5 and 32
Pounds
42.4 and 47.6
Kilograms



B-10
23.5 and 28.5
Pounds
35 and 42.4
Kilograms

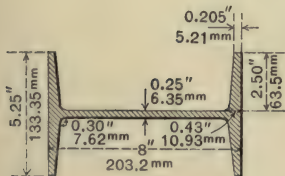


B-9
(Not rolled
at present)
20 and 24
Pounds
29.8 and 35.7
Kilograms



B-8
17.5 and 19.5
Pounds
26 and 29
Kilograms

(Not rolled
at present)

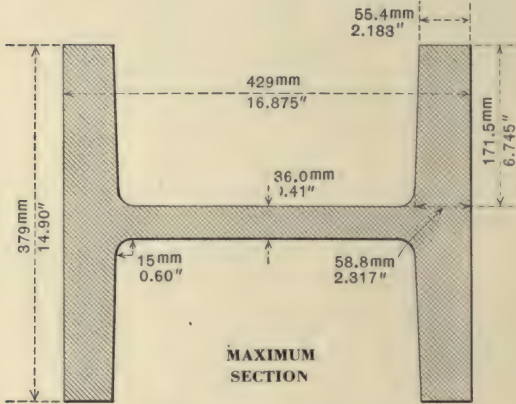


BETHLEHEM ROLLED H-COLUMNS

H-14

287.5 Pounds

427.9 Kilograms

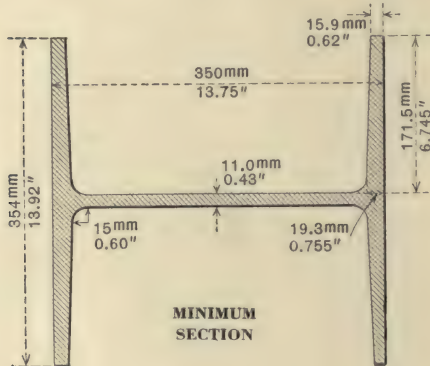


For intermediate weights and dimensions see pages 52-53 and 60-61

H-14

83.5 Pounds

124.3 Kilograms

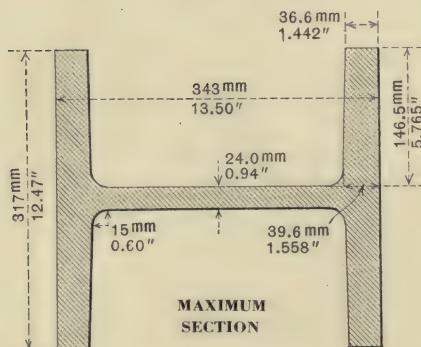


BETHLEHEM ROLLED H-COLUMNS

H-12

161 Pounds

239.6 Kilograms

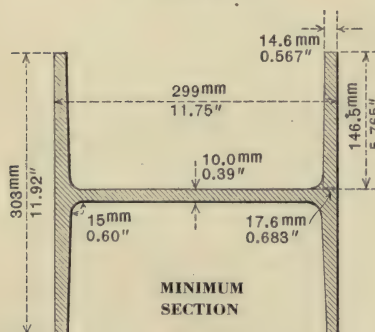


For intermediate weights and dimensions see pages 54-55 and 62-63

H-12

64.5 Pounds

96 Kilograms

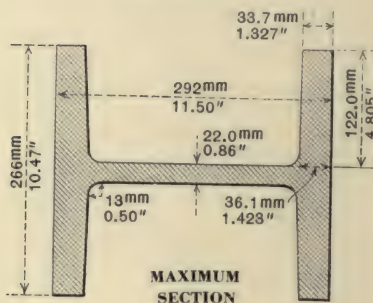


BETHLEHEM ROLLED H-COLUMNS

H-10

123.5 Pounds

183.8 Kilograms

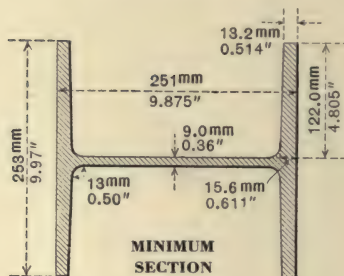


For intermediate weights and dimensions see pages 56-57 and 64-65

H-10

49.0 Pounds

72.9 Kilograms

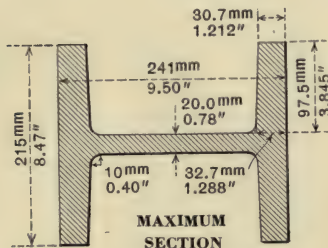


BETHLEHEM ROLLED H-COLUMNS

H-8

90.5 Pounds

134.7 Kilograms

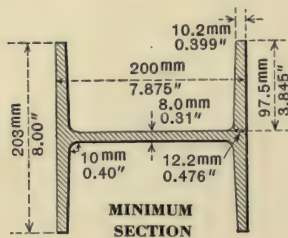


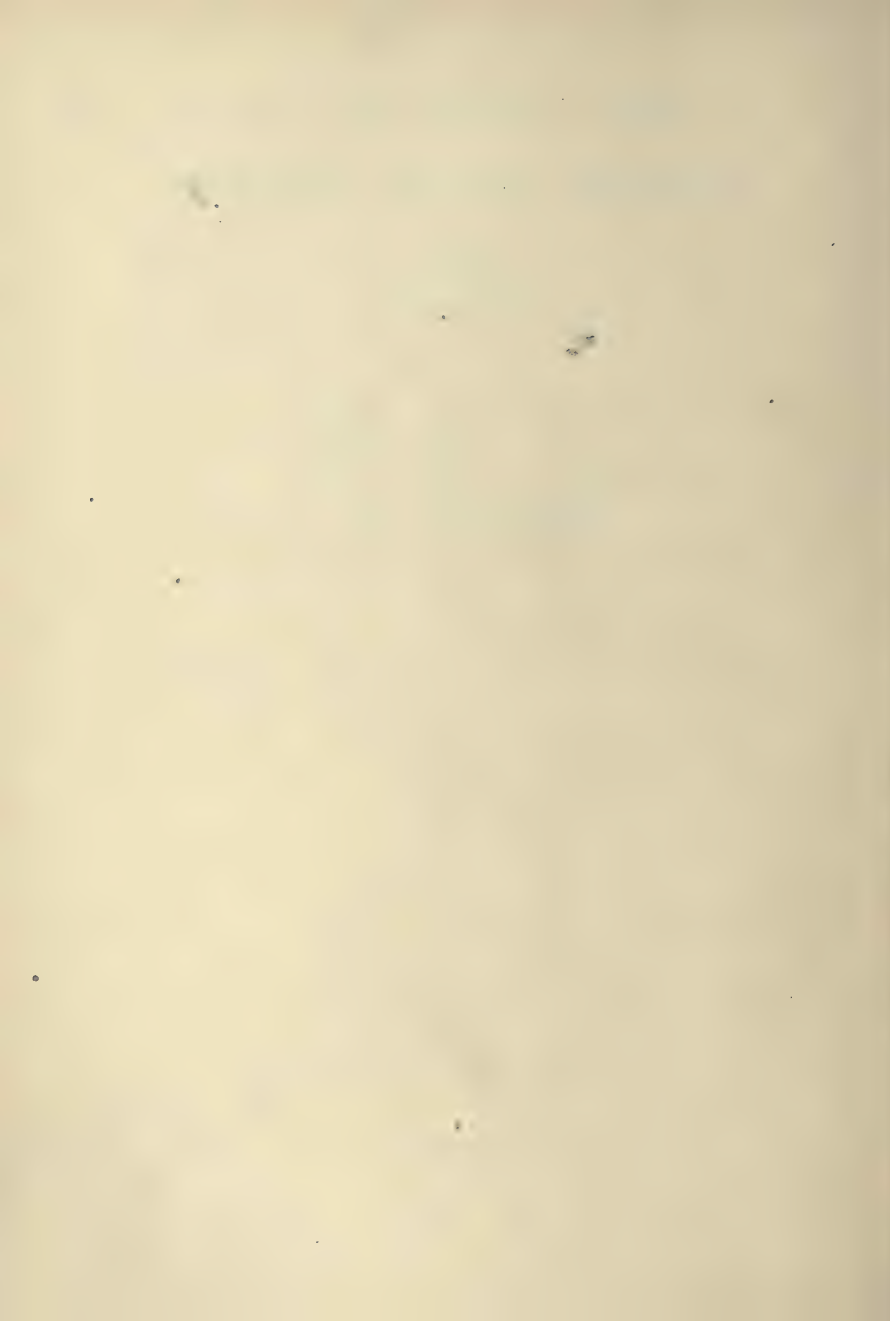
For intermediate weights and dimensions see pages 58-59 and 66-67

H-8

32 Pounds

47.6 Kilograms





DIMENSIONS AND PROPERTIES
OF
BETHLEHEM ROLLED GIRDERS,
I-BEAMS, H-COLUMNS,
AND
14-INCH SPECIAL SECTION

NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

Metric tables are printed on colored paper for convenience of reference.

DIMENSIONS AND PROPERTIES OF BETHLEHEM I-BEAMS AND GIRDER BEAMS

Weights and dimensions of all the sizes of Bethlehem I-Beams usually rolled are given in the tables on pages 29 and 41. Sufficient variations of weights are provided in general for all ordinary purposes of construction. Intermediate or heavier weights may be furnished by special arrangement, but only in variations corresponding to the regular weights of Standard Beams.

Properties of Bethlehem I-Beams are given in the tables on pages 32-33 and 44-45. The minimum weight of each section, from 8 inches to 24 inches in depth, inclusive, has a coefficient of strength or section modulus equal to that of the corresponding minimum weight Standard Beam of the same depth, as will be seen by reference to the tables of comparison on page 37 and 49. Because of their scientifically proportioned profile, the Bethlehem Beams in general weigh 10 per cent less than corresponding Standard Beams of equal strength.

Weights and dimensions of the minimum sections of Bethlehem Girder Beams are given in the tables on pages 28 and 40. Heavier weights may be furnished by special arrangement, but only in increments corresponding to the regular weights of Standard Beams.

Properties of Bethlehem Girder Beams are given in the tables on pages 30-31 and 42-43. From 8 inches to 24 inches in depth, inclusive, these Girder Beams have a coefficient of strength or section modulus equal to that of two corresponding minimum weight Standard Beams of the same depth, as will be seen by reference to the tables of comparison on pages 36 and 48. The weight of the Girder Beam is in general $12\frac{1}{2}$ per cent less than the combined weight of the two corresponding Standard Beams, not including the separators for assembling the latter into a girder of equal strength.

The increase in thickness of web and in width of flanges is given for one pound increase in weight of the beam or girder section, by means of which the dimensions of intermediate or heavier weights can be determined.

Coefficients of strength are given for maximum fiber stresses of 16,000 pounds and 12,500 pounds per square inch and for 1200 kilograms and 1000 kilograms per square centimeter. If the loads are quiescent or nearly so, as in buildings, the coefficients for 16,000 pounds or 1200 kilograms are generally used, but when moving loads are to be supported coefficients for smaller fiber stresses should be used.

These coefficients of strength afford a simple means of finding the safe uniformly distributed load for any beam. Divide the coefficient given for the beam by the length of the span in feet. The quotient is the safe uniformly distributed load in pounds, including the weight of the beam.

To select a beam to support a given load on a given span, find the coefficient of strength required and refer to the tables for a beam having a coefficient of that value. The coefficient required is found by multiplying the uniformly distributed load in pounds by the span in feet.

If the load is concentrated at the center of the span the safe load is one-half the safe uniformly distributed load for the same span. To select a beam for supporting a load concentrated at the center of the span, multiply the given load by 2 and consider the result as a uniform load.

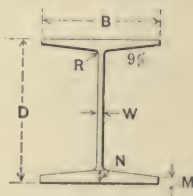
If the load is not uniformly distributed or not concentrated at the center of span, the bending moment must be employed. The moment of resistance of the beam, in foot-pounds, must be equal to the bending moment of the loading in foot-pounds. Moments of resistance, in foot-pounds, for Bethlehem I-Beams and Girder Beams are given on pages 34-35 and 46-47.

In selecting the proper beam required to support a given loading the section modulus may also be used. The section modulus required is found by dividing the bending moment of the loading, in inch-pounds, by the allowable fiber stress in pounds per square inch.

The maximum fiber stress, in pounds per square inch, in a beam supporting a given loading is found by dividing the bending moment produced by the loading, in inch-pounds, by the section modulus of the beam.

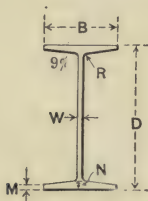
In the case of very short spans, or of heavy concentrated loads, the crippling strength of the web may limit the safe allowable load on a beam or determine the selection of a beam for supporting a given loading. The tables on pages 128 and 129 give the maximum safe shear on the webs, calculated by the customary formula for that purpose, as explained on page 127.

WEIGHTS AND DIMENSIONS OF BETHLEHEM ROLLED GIRDER BEAMS



Section Number	Weight per Foot, Pounds	Dimensions, in Inches					
		Depth D	Flange Width B	Web Thickness W	Flange Thickness		Radius of Fillet R
					At Edge M	At Root N	
G-30-a	200.0	30	15.00	.750	0.950	1.591	.90
G-30	180.0	30	13.00	.690	1.035	1.589	.90
G-28	165.0	28	12.50	.660	1.000	1.533	.85
G-26-a	160.0	26	13.60	.630	0.885	1.469	.80
G-26	150.0	26	12.00	.630	0.995	1.469	.80
G-24-a	140.0	24	13.00	.600	0.800	1.358	.70
G-24	120.0	24	12.00	.530	0.730	1.246	.70
G-20-a	140.0	20	12.50	.640	0.930	1.464	.75
G-20	112.0	20	12.00	.550	0.695	1.210	.65
G-18	92.0	18	11.50	.480	0.590	1.087	.60
G-15-b	140.0	15	11.75	.800	1.090	1.533	.95
G-15-a	104.0	15	11.25	.600	0.770	1.249	.75
G-15	73.0	15	10.50	.430	0.520	0.974	.55
G-12-a	70.0	12	10.00	.460	0.575	1.004	.55
G-12	55.0	12	9.75	.370	0.415	0.837	.45
G-10	44.0	10	9.00	.310	0.370	0.763	.40
G-9	38.0	9	8.50	.300	0.335	0.704	.40
G-8	32.5	8	8.00	.290	0.295	0.642	.40

WEIGHTS AND DIMENSIONS OF BETHLEHEM I-BEAMS



Section Number	Weight per Foot, Pounds	Dimensions in Inches					
		Depth D	Flange Width B	Web Thickness W	Flange Thickness		Radius of Fillet R
					At Edge M	At Root N	
B-30	120.0	30	10.500	.540	.735	1.183	.65
B-28	105.0	28	10.000	.500	.675	1.102	.60
B-26	90.0	26	9.500	.460	.600	1.007	.55
B-24-a	84.0	24	9.250	.460	.585	.980	.55
B-24	83.0	24	9.130	.520	.510	.897	.50
	73.0	24	9.000	.390	.510	.897	.50
B-20-a	82.0	20	8.890	.570	.580	.955	.55
	72.0	20	8.750	.430	.580	.955	.55
B-20	69.0	20	8.145	.520	.475	.818	.45
	64.0	20	8.075	.450	.475	.818	.45
	59.0	20	8.000	.375	.475	.818	.45
	59.0	18	7.675	.495	.430	.753	.40
	54.0	18	7.590	.410	.430	.753	.40
B-18	52.0	18	7.555	.375	.430	.753	.40
	48.5	18	7.500	.320	.430	.753	.40
B-15-b	71.0	15	7.500	.520	.785	1.099	.60
B-15-a	64.0	15	7.195	.605	.590	.887	.50
	54.0	15	7.000	.410	.590	.887	.50
B-15	46.0	15	6.810	.440	.400	.686	.40
	41.0	15	6.710	.340	.400	.686	.40
	38.0	15	6.660	.290	.400	.686	.40
B-12-a	36.0	12	6.300	.310	.440	.710	.40
B-12	32.0	12	6.205	.335	.330	.594	.35
	28.5	12	6.120	.250	.330	.594	.35
B-10	28.5	10	5.990	.390	.270	.522	.30
	23.5	10	5.850	.250	.270	.522	.30

PROPERTIES OF BETHLEHEM GIRDER BEAMS

Section Num- ber	Depth of Beam, Inches	Weight per Foot, Pounds	Area of Sec- tion, Square Inches	Thick- ness of Web, Inches	Width of Flange, Inches	In- crease of Web and Flange for Each Pound In- crease of Weight, Inches	Neutral Axis Perpen- dicular to Web at Center		
							Mom- ent of Inertia I	Ra- dius of Gyra- tion r	Sec- tion Modu- lus S
G-30-a	30	200.0	58.71	.750	15.00	.010	9150.6	12.48	610.0
G-30	30	180.0	53.00	.690	13.00	.010	8194.5	12.43	546.3
G-28	28	165.0	48.47	.660	12.50	.011	6562.7	11.64	468.8
G-26-a	26	160.0	46.91	.630	13.60	.011	5620.8	10.95	432.4
G-26	26	150.0	43.94	.630	12.00	.011	5153.9	10.83	396.5
G-24-a	24	140.0	41.16	.600	13.00	.012	4201.4	10.10	350.1
G-24	24	120.0	35.38	.530	12.00	.012	3607.3	10.10	300.6
G-20-a	20	140.0	41.19	.640	12.50	.015	2934.7	8.44	293.5
G-20	20	112.0	32.81	.550	12.00	.015	2342.1	8.45	234.2
G-18	18	92.0	27.12	.480	11.50	.016	1591.4	7.66	176.8
G-15-b	15	140.0	41.27	.800	11.75	.020	1592.7	6.21	212.4
G-15-a	15	104.0	30.50	.600	11.25	.020	1220.1	6.32	162.7
G-15	15	73.0	21.49	.430	10.50	.020	883.4	6.41	117.8
G-12-a	12	70.0	20.58	.460	10.00	.025	538.8	5.12	89.8
G-12	12	55.0	16.18	.370	9.75	.025	432.0	5.17	72.0
G-10	10	44.0	12.95	.310	9.00	.030	244.2	4.34	48.8
G-9	9	38.0	11.22	.300	8.50	.033	170.9	3.90	38.0
G-8	8	32.5	9.54	.290	8.00	.037	114.4	3.46	28.6

W = Safe load in pounds, uniformly distributed, including weight of beam

L = Span, in feet. M = Moment of forces, in foot pounds.

PROPERTIES OF BETHLEHEM GIRDER BEAMS

Coefficient of Strength				Maximum Safe Shear on Web, in Pounds	Neutral Axis Coincident with Center Line of Web		Section Number
For Fiber Stress of 16,000 Pounds per Square Inch for Buildings C	Add for Each Pound Increase in Weight of Beam	For Fiber Stress of 12,500 Pounds per Square Inch for Moving Loads C'	Add for Each Pound Increase in Weight of Beam		Moment of Inertia I'	Radius of Gy- ration r'	
6,507,100	15690	5,083,700	12270	189,300	630.2	3.28	G-30-a
5,827,200	15690	4,552,500	12270	165,200	433.3	2.86	G-30-
5,000,100	14640	3,906,400	11450	150,300	371.9	2.77	G-28
4,611,900	13600	3,603,100	10630	135,900	435.7	3.05	G-26-a
4,228,800	13600	3,303,800	10630	135,900	314.6	2.68	G-26
3,734,600	12550	2,917,600	9820	121,700	346.9	2.90	G-24-a
3,206,500	12550	2,505,100	9820	98,500	249.4	2.66	G-24
3,130,300	10460	2,445,600	8180	124,200	348.9	2.91	G-20-a
2,498,300	10460	1,951,800	8180	98,500	239.3	2.70	G-20
1,886,100	9410	1,473,500	7360	76,100	182.6	2.59	G-18
2,265,200	7840	1,769,700	6140	134,200	331.0	2.83	G-15-b
1,735,300	7840	1,355,700	6140	94,300	213.0	2.64	G-15a
1,256,600	7840	981,600	6140	59,200	123.2	2.39	G-15
957,800	6280	748,300	4910	57,200	114.7	2.36	G-12a
768,000	6280	600,000	4910	42,300	81.1	2.24	G-12
521,000	5230	407,000	4090	29,800	57.3	2.10	G-10
405,000	4710	316,400	3680	26,700	44.1	1.98	G-9
305,100	4180	238,300	3270	23,600	32.9	1.86	G-8

C and C' = Coefficients given in the tables.

$$W = \frac{C \text{ or } C'}{L}; \quad M = \frac{C \text{ or } C'}{8}; \quad C \text{ or } C' = WL = 8M = \frac{2}{3} f S.$$

PROPERTIES OF BETHLEHEM I-BEAMS

Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Area of Section, Square Inches	Thickness of Web, Inches	Width of Flange, Inches	Increase of Web and Flange for Each Pound Increase of Weight, Inches	Neutral Axis Perpendicular to Web at Center		
							Moment of Inertia I	Radius of Gyration r	Section Modulus S
B-30	30	120.0	35.30	.540	10.500	.010	5239.6	12.18	349.3
B-28	28	105.0	30.88	.500	10.000	.011	4011.1	11.40	286.7
B-26	26	90.0	26.49	.460	9.500	.011	2977.2	10.60	229.0
B-24-a	24	84.0	21.80	.460	9.250	.012	2381.9	9.80	198.5
B-24	24	83.0	21.59	.520	9.130	.012	2240.9	9.55	186.7
	24	73.0	21.17	.390	9.000	.012	2091.0	9.87	174.3
B-20-a	20	82.0	21.17	.570	8.890	.015	1559.8	8.03	156.0
	20	72.0	21.37	.430	8.750	.015	1466.5	8.28	146.7
B-20	20	69.0	20.26	.520	8.145	.015	1268.9	7.91	126.9
	20	64.0	18.86	.450	8.075	.015	1222.1	8.05	122.2
B-18	20	59.0	17.36	.375	8.000	.015	1172.2	8.22	117.2
	18	59.0	17.40	.495	7.675	.016	883.3	7.12	98.1
	18	54.0	15.87	.410	7.590	.016	812.0	7.28	93.6
	18	52.0	15.24	.375	7.555	.016	825.0	7.36	91.7
B-15-b	18	48.5	14.25	.320	7.500	.016	798.3	7.48	88.7
	15	71.0	20.95	.520	7.500	.020	796.2	6.16	106.2
B-15-a	15	64.0	18.81	.605	7.195	.020	661.9	5.95	88.6
	15	54.0	15.88	.410	7.000	.020	610.0	6.20	81.3
B-15	15	46.0	13.52	.440	6.810	.020	481.8	5.99	61.6
	15	41.0	12.02	.340	6.710	.020	456.7	6.16	60.9
	15	38.0	11.27	.290	6.660	.020	442.6	6.27	59.0
B-12-a	12	36.0	10.61	.310	6.300	.025	269.2	5.04	44.9
B-12	12	32.0	9.44	.335	6.205	.025	228.5	4.92	38.1
	12	28.5	8.42	.250	6.120	.025	216.2	5.07	36.0
B-10	10	28.5	8.34	.390	5.990	.029	134.6	4.02	26.9
	10	23.5	6.94	.250	5.850	.029	122.9	4.21	24.6

W = Safe load in pounds, uniformly distributed, including weight of beam.

L = Span, in feet.

M = Moment of forces, in foot pounds.

PROPERTIES OF BETHLEHEM I-BEAMS

Coefficients of Strength				Maximum Safe Shear on Web, in Pounds	Neutral Axis Coincident with Center Line of Web		Section Number
For Fiber Stress of 16,000 Pounds per Square Inch for Buildings C	Add for Each Pound Increase in Weight of Beam	For Fiber Stress of 12,500 Pounds per Square Inch for Moving Loads C'	Add for Each Pound Increase in Weight of Beam		Moment of Inertia I'	Radius of Gyration r'	
3,726,000	15690	2,910,900	12270	103,800	165.0	2.16	B-30
3,058,400	14610	2,389,300	11450	89,000	131.5	2.06	B-28
2,442,800	13600	1,908,500	10630	75,300	101.2	1.95	B-26
2,117,300	12550	1,654,100	9820	75,100	91.1	1.92	B-24-a
1,991,900	12550	1,556,200	9820	93,100	78.0	1.78	B-24
1,858,700	12550	1,452,100	9820	54,000	74.4	1.86	
1,663,800	10160	1,299,800	8180	102,400	79.9	1.82	B-20-a
1,564,300	10160	1,222,100	8180	64,900	75.9	1.88	
1,353,500	10160	1,057,400	8180	88,200	51.2	1.59	B-20
1,303,600	10460	1,018,500	8180	69,400	49.8	1.62	
1,250,300	10460	976,800	8180	50,000	48.3	1.66	B-18
1,046,900	9410	817,900	7360	78,000	39.1	1.50	
997,900	9410	779,600	7360	57,500	37.7	1.54	
977,700	9410	763,900	7360	49,200	37.1	1.56	
946,100	9410	739,100	7360	36,700	36.2	1.59	B-15-b
1,132,400	7840	884,700	6140	77,900	61.3	1.71	
945,600	7840	738,700	6140	93,900	41.9	1.49	B-15-a
867,600	7840	677,800	6140	54,800	38.3	1.55	
689,500	7840	538,600	6140	60,000	25.2	1.36	B-15
649,400	7840	507,400	6140	39,900	21.0	1.41	
629,500	7840	491,800	6140	30,100	23.4	1.44	
478,600	6280	373,900	4910	32,200	21.3	1.42	B-12-a
406,200	6280	317,300	4910	35,800	16.0	1.30	B-12
384,400	6280	300,300	4910	22,200	15.3	1.35	
287,100	5230	224,300	4090	39,800	12.1	1.21	B-10
262,200	5230	204,800	4090	21,000	11.2	1.27	

C and C' = Coefficients given in the table.

$$W = \frac{C \text{ or } C'}{L}; \quad M = \frac{C \text{ or } C'}{8}; \quad C \text{ or } C' = WL = 8M = \frac{2}{3} fS.$$

MOMENTS OF RESISTANCE OF BETHLEHEM GIRDER BEAMS IN FOOT POUNDS

NEUTRAL AXIS PERPENDICULAR TO WEB AT CENTER

Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Moments of Resistance in Foot Pounds		
			For Fiber Stress of 16,000 Pounds per Square Inch R	For Fiber Stress of 12,500 Pounds per Square Inch R'	For Fiber Stress of 10,000 Pounds per Square Inch R''
G-30-a	30	200	813,390	635,460	508,370
G-30	30	180	728,400	569,070	455,250
G-28	28	165	625,020	488,290	390,640
G-26-a	26	160	576,490	450,380	360,310
G-26	26	150	528,600	412,970	330,380
G-24-a	24	140	466,820	364,710	291,760
G-24	24	120	400,820	313,140	250,510
G-20-a	20	140	391,280	305,700	244,560
G-20	20	112	312,290	243,970	195,180
G-18	18	92	235,760	184,190	147,350
G-15-b	15	140	283,150	221,210	176,970
G-15-a	15	104	216,910	169,460	135,570
G-15	15	73	157,080	122,700	98,170
G-12-a	12	70	119,730	93,540	74,830
G-12	12	55	96,000	75,000	60,000
G-10	10	44	65,130	50,880	40,700
G-9	9	38	50,630	39,550	31,640
G-8	8	32.5	38,140	29,790	23,830

W=Total uniformly distributed load, in pounds, including weight of beam.

P = Load, in pounds, at center of span.

L = Span in feet. M = Bending Moment of forces, in foot pounds.

MOMENTS OF RESISTANCE OF BETHLEHEM I-BEAMS

IN FOOT POUNDS

NEUTRAL AXIS PERPENDICULAR TO WEB AT CENTER

Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Moments of Resistance in Foot Pounds		
			For Fiber Stress of 16,000 Pounds per Square Inch R	For Fiber Stress of 12,500 Pounds per Square Inch R'	For Fiber Stress of 10,000 Pounds per Square Inch R''
B-30	30	120.0	465,740	363,860	291,090
B-28	28	105.0	382,300	298,670	238,930
B-26	26	90.0	305,350	238,560	190,850
B-24-a	24	84.0	264,660	206,760	165,410
B-24	24	83.0	248,980	194,520	155,620
	24	73.0	232,340	181,510	145,210
B-20-a	20	82.0	207,980	162,480	129,980
	20	72.0	195,540	152,760	122,210
B-20	20	69.0	169,190	132,170	105,740
	20	64.0	162,950	127,310	101,850
	20	59.0	156,290	122,100	97,680
	18	59.0	130,860	102,230	81,790
B-18	18	54.0	124,740	97,450	77,960
	18	52.0	122,220	95,480	76,390
	18	48.5	118,260	92,390	73,910
B-15-b	15	71.0	141,540	110,580	88,470
B-15-a	15	64.0	118,200	92,340	73,870
	15	54.0	108,450	84,730	67,780
B-15	15	46.0	86,180	67,330	53,860
	15	41.0	81,180	63,420	50,740
	15	38.0	78,680	61,470	49,180
B-12-a	12	36.0	59,830	46,740	37,390
B-12	12	32.0	50,770	39,670	31,730
	12	28.5	48,050	37,540	30,030
B-10	10	28.5	35,880	28,030	22,430
	10	23.5	32,770	25,600	20,480

R, R' and R'' = Moments of resistance given in the tables.

$$M = R, R' \text{ or } R'' : R, R' \text{ or } R'' = \frac{1}{8}WL : R, R' \text{ or } R'' = \frac{1}{4}PL + \frac{1}{8}WL.$$

COMPARISON OF BETHLEHEM GIRDER BEAMS WITH GIRDERS OF STANDARD BEAMS

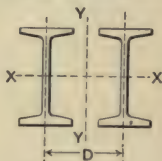
Bethlehem Girder Beams				Equivalent Girders of Standard Beams				Economy of Bethlehem Beams, Pounds per Foot
Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Section Modulus	Number of Beams	Depth of Beams, Inches	Weight of Each Beam, Pounds per Foot	Section Modulus of Two Beams	
G-30-a	30	200.0	610.0					
G-30	30	180.0	546.3					
G-28	28	165.0	468.8					
G-26-a	26	160.0	432.4					
G-26	26	150.0	396.5	2	24	100	396.8	50
G-24-a	24	140.0	350.1	2	24	80	348.0	20
G-24	24	120.0	300.6	2	20	85	301.8	50
G-20-a	20	140.0	293.5	2	20	80	293.4	20
G-20	20	112.0	234.2	2	20	65	234.0	18
G-18	18	92.0	176.8	2	18	55	176.8	18
G-15-b	15	140.0	212.4	2	15	80	212.2	20
G-15-a	15	104.0	162.7	2	15	60	162.4	16
G-15	15	73.0	117.8	2	15	42	117.8	11
G-12-a	12	70.0	89.8	2	12	40	89.6	10
G-12	12	55.0	72.0	2	12	31.5	72.0	8
G-10	10	44.0	48.8	2	10	25	48.8	6
G-9	9	38.0	38.0	2	9	21	37.8	4
G-8	8	32.5	28.6	2	8	18	28.4	3.5

The difference in weights does not include separators for assembling the Standard Beams into girders. The weights of such separators vary from about 1.5 pounds per foot for 8-inch beams to about 5.5 pounds per foot for 24-inch beams. The actual economy in weight of the Bethlehem Girder Beams is increased to the same extent.

COMPARISON OF BETHLEHEM I-BEAMS WITH STANDARD I-BEAMS

Bethlehem I-Beams				Equivalent Standard Beams			Economy of Beth- lehem Beams, Pounds per Foot
Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Section Modulus	Depth of Beam, Inches	Weight per Foot, Pounds	Section Modulus	
B-30	30	120.0	349.3				
B-28	28	105.0	286.7				
B-26	26	90.0	229.0				
B-24-a	24	84.0	198.5	24	100	198.4	16.0
B-24	24	83.0	186.7	24	90	186.6	7.0
	24	73.0	174.3	24	80	174.0	7.0
B-20-a	20	82.0	156.0	20	90	155.8	8.0
	20	72.0	146.7	20	80	146.7	8.0
B-20	20	69.0	126.9	20	75	126.9	6.0
	20	64.0	122.2	20	70	122.0	6.0
	20	59.0	117.2	20	65	117.0	6.0
B-18	18	59.0	98.1	18	65	97.9	6.0
	18	54.0	93.6	18	60	93.5	6.0
	18	52.0	91.7				
	18	48.5	88.7	18	55	88.4	6.5
B-15-b	15	71.0	106.2	15	80	106.1	9.0
B-15-a	15	64.0	88.6	15	70	88.5	6.0
	15	54.0	81.3	15	60	81.2	6.0
B-15	15	46.0	64.6	15	50	64.5	4.0
	15	41.0	60.9	15	45	60.8	4.0
	15	38.0	59.0	15	42	58.9	4.0
B-12-a	12	36.0	44.9	12	40	44.8	4.0
B-12	12	32.0	38.1	12	35	38.0	3.0
	12	28.5	36.0	12	31.5	36.0	3.0
B-10	10	28.5	26.9	10	30	26.8	1.5
	10	23.5	24.6	10	25	24.4	1.5

SPACING OF BETHLEHEM I-BEAMS AND GIRDER BEAMS CENTER TO CENTER TO PRODUCE EQUAL RADII OF GYRATION ABOUT BOTH AXES XX AND YY



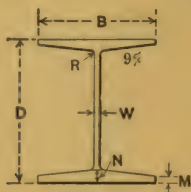
I-Beams				Girder Beams			
Section Number	Depth of Beam, Inches	Weight per Foot of Each Beam, Pounds	Spacing on Centers, in Inches D	Section Number	Depth of Beam, Inches	Weight per Foot of Each Beam, Pounds	Spacing on Centers, in Inches D
B-30	30	120.0	23.98	G-30-a	30	200.0	24.09
B-28	28	105.0	22.43	G-30	30	180.0	24.20
B-26	26	90.0	20.84	G-28	28	165.0	22.60
B-24-a	24	84.0	19.22	G-26-a	26	160.0	21.03
	24	83.0	18.76	G-26	26	150.0	20.99
B-24	24	73.0	19.38	G-24-a	24	140.0	19.35
	20	82.0	15.65	G-24	24	120.0	19.48
B-20-a	20	72.0	16.13	G-20-a	20	140.0	15.85
	20	69.0	15.51	G-20	20	112.0	16.01
B-20	20	64.0	15.77	G-18	18	92.0	14.41
	20	59.0	16.09	G-15-b	15	140.0	*11.06
	18	59.0	13.93	G-15-a	15	104.0	11.49
B-18	18	54.0	14.24	G-15	15	73.0	11.89
	18	52.0	14.38	G-12-a	12	70.0	*9.08
	18	48.5	14.62	G-12	12	55.0	*9.31
B-15-b	15	71.0	11.85	G-10	10	44.0	*7.60
	15	64.0	11.51	G-9	9	38.0	*6.72
B-15-a	15	54.0	12.00	G-8	8	32.5	*5.85
	15	46.0	11.66				
B-15	15	41.0	12.00				
	15	38.0	12.20				
B-12-a	12	36.0	9.67				
	12	32.0	9.49				
B-12	12	28.5	9.77				
	10	28.5	7.67				
B-10	10	23.5	8.03				

* Denotes that the value of D given is less than the distance center to center of beams when placed close together with flanges in contact.

NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

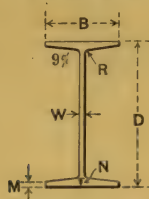
Metric tables are printed on colored paper for convenience of reference.

WEIGHTS AND DIMENSIONS OF BETHLEHEM ROLLED GIRDER BEAMS



Number of Section	Weight per Meter	Weight per Foot	Dimensions, in Millimeters					
			Depth	Width of Flange	Thick- ness of Web	Thickness of Flange		Radius of Fillet
						At Edge	At Root	
	Kg.	Pounds	D	B	W	M	N	R
G-30-a	297.6	200.0	762	381	19.0	21.1	40.4	23
G-30	267.9	180.0	762	330	17.6	26.3	40.4	23
G-28	245.6	165.0	711	318	16.8	25.4	38.9	22
G-26-a	238.1	160.0	660	345	16.0	22.5	37.3	20
G-26	223.2	150.0	660	305	16.0	24.3	37.3	20
G-24-a	208.3	140.0	610	330	15.2	20.3	34.5	18
G-24	178.6	120.0	610	305	13.4	18.5	31.6	18
G-20-a	208.3	140.0	508	318	16.4	23.6	37.2	19
G-20	166.7	112.0	508	305	14.0	17.7	30.7	17
G-18	136.9	92.0	457	292	12.2	15.0	27.6	15
G-15-b	208.3	140.0	381	298	20.4	27.7	40.2	24
G-15-a	154.8	104.0	381	286	15.2	19.6	31.7	19
G-15	108.6	73.0	381	267	11.0	13.2	24.7	14
G-12-a	104.2	70.0	305	254	11.8	14.6	25.5	14
G-12	81.9	55.0	305	248	9.4	10.5	21.3	11
G-10	65.5	44.0	254	229	8.0	9.4	19.4	10
G-9	56.6	38.0	229	216	7.6	8.5	17.9	10
G-8	48.4	32.5	203	203	7.4	7.5	16.3	10

WEIGHTS AND DIMENSIONS OF BETHLEHEM I-BEAMS



Number of Section	Weight per Meter	Weight per Foot	Dimensions, in Millimeters					
			Depth	Width of Flange	Thick-ness of Web	Thickness of Flange		Radius of Fillet
						At Edge	At Root	
	Kg.	Pounds	D	B	W	M	N	R
B-30	178.6	120.0	762	267	13.8	18.7	30.1	17
B-28	156.3	105.0	711	254	12.8	17.1	28.0	15
B-26	133.9	90.0	660	241	11.8	15.2	25.6	14
B-24-a	125.0	84.0	610	235	11.8	14.9	24.9	14
B-24	123.5	83.0	610	232	13.2	13.0	22.8	13
	108.6	73.0	610	229	10.0	13.0	22.8	13
B-20-a	122.0	82.0	508	226	11.5	11.7	21.3	14
	107.2	72.0	508	222	11.0	11.7	21.3	14
B-20	102.7	69.0	508	207	13.2	12.1	20.8	11
	95.2	64.0	508	205	11.4	12.1	20.8	11
	87.8	59.0	508	203	9.6	12.1	20.8	11
B-18	87.8	59.0	457	195	12.6	10.9	19.1	10
	80.4	54.0	457	193	10.4	10.9	19.1	10
	77.4	52.0	457	192	9.5	10.9	19.1	10
	72.2	48.5	457	191	8.2	10.9	19.1	10
B-15-b	105.7	71.0	381	191	13.2	19.9	27.9	15
B-15-a	95.2	64.0	381	183	15.4	15.0	22.5	13
	80.4	54.0	381	178	10.4	15.0	22.5	13
B-15	68.5	46.0	381	173	11.2	10.2	17.4	10
	61.0	41.0	381	170	8.6	10.2	17.4	10
	56.6	38.0	381	169	7.4	10.2	17.4	10
B-12-a	53.6	36.0	305	160	8.0	11.2	18.0	10
B-12	47.6	32.0	305	158	8.5	8.4	15.1	9
	42.4	28.5	305	155	6.4	8.4	15.1	9
B-10	42.4	28.5	254	152	9.9	6.9	13.3	8
	35.0	23.5	254	149	6.4	6.9	13.3	8



PROPERTIES OF BETHLEHEM ROLLED GIRDER BEAMS

Number of Section	Depth of Beam	Weight per Meter	Area of Section	Thick- ness of Web	Width of Flange	Neutral Axis XX		
						Moment of Inertia	Radius of Gy- ration	Modu- lus of Section
						I	r	S
						Cm. ⁴	Cm.	Cm. ³
G-30-a	762	297.6	378.8	19.0	381	380,880	31.70	9996
G-30	762	267.9	341.9	17.6	330	341,084	31.57	8952
G-28	711	245.6	312.7	16.8	318	273,163	29.57	7682
G-26-a	660	238.1	302.6	16.0	345	233,957	27.81	7086
G-26	660	223.2	283.5	16.0	305	214,523	27.51	6498
G-24-a	610	208.3	265.5	15.2	330	174,877	25.65	5737
G-24	610	178.6	228.3	13.4	305	150,148	25.65	4926
G-20-a	508	208.3	265.7	16.4	318	122,152	21.44	4810
G-20	508	166.7	211.7	14.0	305	97,486	21.46	3838
G-18	457	136.9	175.0	12.2	292	66,240	19.46	2897
G-15-b	381	208.3	266.3	20.4	298	66,294	15.77	3481
G-15-a	381	154.8	196.8	15.2	286	50,785	16.05	2666
G-15	381	108.6	138.6	11.0	267	36,770	16.28	1930
G-12-a	305	104.2	132.8	11.8	254	22,427	13.00	1472
G-12	305	81.9	104.4	9.4	248	17,981	13.13	1180
G-10	254	65.5	83.5	8.0	229	10,164	11.02	800
G-9	229	56.6	72.4	7.6	216	7,113	9.91	623
G-8	203	48.4	61.5	7.4	203	4,762	8.79	469

W=Safe load in kilograms, uniformly distributed, including weight of beam. S=Modulus of section. L=Span in meters. M=Moment of forces in kilogram meters. f=Maximum fiber stress, in kilograms per square centimeter.

PROPERTIES OF BETHLEHEM ROLLED GIRDER BEAMS



Coefficients of Strength		Maximum Safe Shear on Web in Kilo- grams	Neutral Axis YY		Depth of Beam	Weight per Foot	Number of Section
For Fiber Stress of 1200 Kilograms per Square Centimeter for Buildings	For Fiber Stress of 1000 Kilograms per Square Centimeter for Moving Loads		Moment of Inertia	Radius of Gyra- tion			
			I'	r'			
C	C'	Kg.	Cm ⁴	Cm.	Inches	Pounds	
959,690	799,740	89,050	26,231	8.33	30	200.0	G-30-a
859,420	716,180	77,720	18,035	7.26	30	180.0	G-30
737,430	614,530	70,710	15,480	7.04	28	165.0	G-28
680,180	566,820	63,930	18,135	7.75	26	160.0	G-26-a
623,680	519,730	63,930	13,095	6.81	26	150.0	G-26
550,790	458,990	57,250	14,439	7.37	24	140.0	G-24-a
472,910	391,090	46,340	10,381	6.76	24	120.0	G-24
461,670	384,720	58,430	14,522	7.39	20	140.0	G-20-a
368,460	307,050	46,430	9,961	6.86	20	112.0	G-20
278,170	231,810	35,800	7,600	6.58	18	92.0	G-18
334,080	278,400	63,130	13,777	7.19	15	140.0	G-15-b
255,930	213,270	44,360	8,866	6.71	15	104.0	G-15-a
185,330	154,440	27,850	5,128	6.07	15	73.0	G-15
141,260	117,720	26,910	4,774	5.99	12	70.0	G-12-a
113,270	94,390	19,900	3,376	5.69	12	55.0	G-12
76,840	64,030	14,020	2,385	5.33	10	44.0	G-10
59,730	49,780	12,560	1,836	5.03	9	38.0	G-9
45,000	37,500	11,100	1,369	4.72	8	32.5	G-8

C and C' = Coefficients given in the tables.

$$W = \frac{C \text{ or } C'}{L} ; M = \frac{C \text{ or } C'}{8} ; C \text{ or } C' = WL = 8M = \frac{8}{100} \text{ fs.}$$



PROPERTIES OF BETHLEHEM I-BEAMS

Number of Section	Depth of Beam	Weight per Meter	Area of Section	Thick-ness of Web	Width of Flange	Neutral Axis XX		
						Moment of Inertia	Radius of Gyration	Modu-lus of Section
						I	r	S
	Mm.	Kg.	Cm. ²	Mm.	Mm.	Cm. ⁴	Cm.	Cm. ³
B-30	762	178.6	227.7	13.8	267	218,090	30.94	5724
B-28	711	156.3	199.2	12.8	254	167,081	28.96	4698
B-26	660	133.9	170.9	11.8	241	123,921	26.92	3753
B-24-a	610	125.0	160.0	11.8	235	99,143	24.89	3253
B-24	610	123.5	158.6	13.2	232	93,274	24.26	3059
	610	108.6	138.5	10.0	229	87,035	25.07	2856
B-20-a	508	122.0	155.9	14.6	226	64,924	20.40	2556
	508	107.2	137.9	11.0	222	61,041	21.03	2404
B-20	508	102.7	130.7	13.2	207	52,816	20.09	2080
	508	95.2	121.7	11.4	205	50,868	20.45	2003
	508	87.8	112.0	9.6	203	48,791	20.88	1921
	457	87.8	112.3	12.6	195	36,766	18.08	1608
B-18	457	80.4	102.4	10.4	193	35,047	18.49	1531
	457	77.4	98.3	9.6	192	34,339	18.69	1503
	457	72.2	91.9	8.2	191	33,228	19.00	1454
B-15-b	381	105.7	135.2	13.2	191	33,141	15.65	1740
B-15-a	381	95.2	121.4	15.4	183	27,675	15.11	1452
	381	80.4	102.5	10.4	178	25,390	15.75	1332
B-15	381	68.5	87.2	11.2	173	20,179	15.22	1059
	381	61.0	77.5	8.6	170	19,009	15.65	998
	381	56.6	72.7	7.4	169	18,423	15.93	967
B-12-a	305	53.6	68.5	8.0	160	11,205	12.80	736
B-12	305	47.6	60.9	8.6	158	9,511	12.50	624
	305	42.4	54.3	6.4	155	8,999	12.88	590
B-10	254	42.4	53.8	10.0	152	5,603	10.21	441
	254	35.0	44.8	6.4	149	5,116	10.69	403

W=Safe load in kilograms, uniformly distributed, including weight of beam. S=Modulus of section. L=Span, in meters. M=Moment of forces in kilogram meters. f=Maximum fiber stress, in kilograms per square centimeter.

PROPERTIES OF BETHLEHEM I-BEAMS



Coefficients of Strength		Maximum Safe Shear on Web in Kilo- grams	Neutral Axis YY		Depth of Beam	Weight per Foot	Number of Section
For Fiber Stress of 1200 Kilograms per Square Centimeter for Buildings	For Fiber Stress of 1000 Kilograms per Square Centimeter for Moving Loads		Moment of Inertia	Radius of Gyra- tion			
C	C'	Kg.	I' Cm ⁴	r' M.	Inches	Pounds	
549,530	457,940	48,830	6,868	5.49	30	120.0	B-30
451,070	375,890	41,870	5,474	5.23	28	105.0	B-28
360,270	300,230	35,420	4,212	4.95	26	90.0	B-26
312,270	260,220	35,330	3,792	4.88	24	84.0	B-24-a
293,770	244,810	43,800	3,247	4.52	24	83.0	B-24
274,130	228,440	25,400	3,097	4.72	24	73.0	
245,380	204,490	48,170	3,326	4.62	20	82.0	B-20-a
230,710	192,260	30,530	3,159	4.78	20	72.0	
199,620	166,350	41,490	2,131	4.04	20	69.0	B-20
192,260	160,220	32,650	2,073	4.11	20	64.0	
184,400	153,670	23,520	2,010	4.22	20	59.0	B-18
154,400	128,670	36,690	1,627	3.81	18	59.0	
147,170	122,650	27,050	1,569	3.91	18	54.0	
144,200	120,160	23,150	1,544	3.96	18	52.0	
139,530	116,280	17,260	1,507	4.04	18	48.5	B-15-b
167,010	139,180	36,650	2,552	4.34	15	71.0	
139,460	116,220	44,170	1,744	3.78	15	64.0	B-15-a
127,960	106,630	25,780	1,594	3.94	15	54.0	
101,690	84,740	28,230	1,049	3.45	15	46.0	B-15
95,780	79,810	18,770	999	3.58	15	41.0	
92,840	77,370	14,160	974	3.66	15	38.0	B-12-a
70,590	58,820	15,150	887	3.61	12	36.0	
59,910	49,920	16,840	666	3.30	12	32.0	B-12
56,690	47,240	10,440	637	3.43	12	28.5	
42,340	35,290	18,720	504	3.07	10	28.5	B-10
38,670	32,230	9,880	466	3.23	10	23.5	

C and C' = Coefficients given in the table.

$$W = \frac{C \text{ or } C'}{L}; M = \frac{C \text{ or } C'}{8}; C \text{ or } C' = WL = 8M = \frac{8}{100} fS.$$

MOMENTS OF RESISTANCE OF BETHLEHEM ROLLED GIRDER BEAMS

IN KILOGRAM METERS

Neutral Axis Perpendicular to Web at Center

Number of Section	Depth of Beam	Weight per Meter	Moments of Resistance in Kilogram Meters			
			For Fiber Stress of 1200 Kilograms per Square Centimeter	For Fiber Stress of 1000 Kilograms per Square Centimeter	For Fiber Stress of 875 Kilograms per Square Centimeter	For Fiber Stress of 750 Kilograms per Square Centimeter
	Mm.	Kg.	R	R ₁	R ₂	R ₃
G-30-a	762	297.6	119,960	99,970	87,470	74,980
G-30	762	267.9	107,430	89,520	78,330	67,140
G-28	711	245.6	92,180	76,820	67,220	57,610
G-26-a	660	238.1	85,020	70,850	62,000	53,140
G-26	660	223.2	77,960	64,970	56,850	48,730
G-24-a	610	208.3	68,850	57,370	50,200	43,030
G-24	610	178.6	59,110	49,260	43,100	36,950
G-20-a	508	208.3	57,710	48,090	42,080	36,070
G-20	508	166.7	46,060	38,380	33,580	28,790
G-18	457	136.9	34,770	28,980	25,350	21,730
G-15-b	381	208.3	41,760	34,800	30,450	26,100
G-15-a	381	154.8	31,990	26,660	23,330	19,990
G-15	381	108.6	23,170	19,310	16,890	14,480
G-12-a	305	104.2	17,660	14,720	12,880	11,040
G-12	305	81.9	14,160	11,800	10,320	8,850
G-10	254	65.5	9,610	8,000	7,000	6,000
G-9	229	56.6	7,470	6,220	5,440	4,670
G-8	203	48.4	5,630	4,690	4,100	3,520

W = Total uniformly distributed load in kilograms, including weight of beam.

P = Load in kilograms, at center of span.

L = Span in meters.

M = Bending moment of forces, in kilogram meters.

MOMENTS OF RESISTANCE OF BETHLEHEM I-BEAMS

IN KILOGRAM METERS

Neutral Axis Perpendicular to Web at Center

Number of Section	Depth of Beam	Weight per Meter	Moments of Resistance in Kilogram Meters			
			For Fiber Stress of 1200 Kilograms per Square Centimeter	For Fiber Stress of 1000 Kilograms per Square Centimeter	For Fiber Stress of 875 Kilograms per Square Centimeter	For Fiber Stress of 750 Kilograms per Square Centimeter
			R	R ₁	R ₂	R ₃
B-30	762	178.6	68,690	57,240	50,090	42,930
B-28	711	156.3	56,380	46,990	41,110	35,240
B-26	660	133.9	45,030	37,530	32,840	28,150
B-24-a	610	125.0	39,030	32,530	28,460	24,400
B-24	610	123.5	36,720	30,600	26,780	22,950
	610	108.6	34,270	28,560	24,990	21,420
B-20-a	508	122.0	30,670	25,560	22,370	19,170
	508	107.2	28,840	24,030	21,030	18,020
B-20	508	102.7	24,950	20,790	18,190	15,600
	508	95.2	24,030	20,030	17,520	15,020
	508	87.8	23,050	19,210	16,810	14,410
B-18	457	87.8	19,300	16,080	14,070	12,060
	457	80.4	18,400	15,330	13,410	11,500
	457	77.4	18,030	15,020	13,140	11,270
	457	72.2	17,440	14,530	12,720	10,900
B-15-b	381	105.7	20,870	17,400	15,220	13,050
B-15-a	381	95.2	17,430	14,530	12,710	10,900
	381	80.4	15,990	13,330	11,660	10,000
B-15	381	68.5	12,710	10,590	9,270	7,940
	381	61.0	11,970	9,980	8,730	7,480
B-12-a	381	56.6	11,600	9,670	8,460	7,250
	305	53.6	8,820	7,350	6,430	5,520
B-12	305	47.6	7,490	6,240	5,460	4,680
	305	42.4	7,090	5,910	5,170	4,430
B-10	254	42.4	5,290	4,410	3,860	3,310
	254	35.0	4,830	4,030	3,520	3,020

R, R₁, R₂ or R₃ = Moments of resistance given in the tables.

M = R, R₁, R₂ or R₃; $R, R_1, R_2 \text{ or } R_3 = \frac{1}{8} WL$; $R, R_1, R_2 \text{ or } R_3 = \frac{1}{4} PL + \frac{1}{8} WL$.

COMPARISON OF BETHLEHEM GIRDER BEAMS WITH GIRDERS OF STANDARD BEAMS

Bethlehem Rolled Girder Beams				Equivalent Rolled Girders of Standard Beams				Economy of Bethlehem Beams, Kilograms per Meter
Number of Section	Depth of Beam	Weight per Meter	Section Modulus	Num- of Beams	Depth of Beams	Weight of Each Beam, per Meter	Section Modulus of Two Beams	
	Mm.	Kg.	Cm. ³		Mm.	Kg.	Cm. ³	
G-30-a	762	297.6	9996					
G-30	762	267.9	8952					
G-28	711	245.6	7682					
G-26-a	660	238.1	7086					
G-26	660	223.2	6498	2	610	148.8	6502	74.4
G-24-a	610	208.3	5737	2	610	119.1	5703	29.9
G-24	610	178.6	4926	2	508	126.5	4946	74.4
G-20-a	508	208.3	4810	2	508	119.1	4808	29.9
G-20	508	166.7	3838	2	508	96.7	3835	26.7
G-18	457	136.9	2897	2	457	81.9	2897	26.9
G-15-b	381	208.3	3481	2	381	119.1	3477	29.9
G-15-a	381	154.8	2666	2	381	89.3	2661	23.8
G-15	381	108.6	1930	2	381	62.5	1930	16.4
G-12-a	305	104.2	1472	2	305	59.5	1468	14.8
G-12	305	81.9	1180	2	305	46.9	1180	11.9
G-10	254	65.5	800	2	254	37.2	800	8.9
G-9	229	56.6	623	2	229	31.3	619	6.0
G-8	203	48.4	469	2	203	26.8	465	5.2

The difference in weights does not include separators for assembling the standard beams into girders. The weights of such separators vary from about 2.2 kilograms per meter for 203 millimeter beams to about 8.2 kilograms per meter for 610 millimeter beams. The actual economy in weight of the Bethlehem Rolled Girder Beams is increased to the same extent.

COMPARISON OF BETHLEHEM I-BEAMS WITH STANDARD I-BEAMS

Bethlehem I-Beams				Equivalent Standard Beams			Economy of Beth- lehem Beams, Kilo- grams per Meter
Number of Section	Depth of Beam	Weight per Meter	Section Modulus	Depth of Beam	Weight per Meter	Section Modulus	
	Mm.	Kg.	Cm. ³	Mm.	Kg.	Cm. ³	
B-30	762	178.6	5724				
B-28	711	156.3	4698				
B-26	660	133.9	3753				
B-24-a	610	125.0	3253	610	148.8	3251	23.8
B-24	610	123.5	3059	610	133.9	3058	10.4
	610	108.6	2856	610	119.1	2851	10.5
B-20-a	508	122.0	2556	508	133.9	2553	11.9
	508	107.2	2404	508	119.1	2404	11.9
B-20	508	102.7	2080	508	111.6	2080	8.9
	508	95.2	2003	508	104.2	1999	9.0
	508	87.8	1921	508	96.7	1917	8.9
B-18	457	87.8	1608	457	96.7	1604	8.9
	457	80.4	1534	457	89.3	1532	8.9
	457	77.4	1503				
	457	72.2	1454	457	81.9	1449	9.7
B-15-b	381	105.7	1740	381	119.1	1739	13.4
B-15-a	381	95.2	1452	381	104.2	1450	9.0
	381	80.4	1332	381	89.3	1331	8.9
B-15	381	68.5	1059	381	74.4	1057	5.9
	381	61.0	998	381	67.0	996	6.0
	381	56.6	967	381	62.5	965	5.9
B-12-a	305	53.6	736	305	59.5	734	5.9
B-12	305	47.6	624	305	52.1	623	4.5
	305	42.4	590	305	46.9	590	4.5
B-10	254	42.4	441	254	44.6	439	2.2
	254	35.0	403	254	37.2	400	2.2

SPACING OF BETHLEHEM I-BEAMS AND GIRDER BEAMS CENTER TO CENTER

TO PRODUCE EQUAL RADII OF GYRATION
ABOUT BOTH AXES XX AND YY



I-Beams				Rolled Girder Beams			
Num- ber of Section	Depth of Beam, Mm.	Weight per Meter of Each Beam, Kg.	Spacing on Centers, in Centi- meters D	Num- ber of Section	Depth of Beam, Mm.	Weight per Meter of Each Beam, Kg.	Spacing on Centers, in Centi- meters D
B-30	762	178.6	60.91	G-30-a	762	297.6	61.19
B-28	711	156.3	56.97	G-30	762	267.9	61.47
B-26	660	133.9	52.93	G-28	711	245.6	57.40
B-24-a	610	125.0	48.82	G-26-a	660	238.1	53.42
	610	123.5	47.65				
B-24	610	108.6	49.23	G-26	660	223.2	53.31
				G-24-a	610	208.3	49.15
B-20-a	508	122.0	39.75	G-24	610	178.6	49.48
	508	107.2	40.97				
	508	102.7	39.40	G-20-a	508	208.3	40.26
B-20	508	95.2	40.06	G-20	508	166.7	40.67
	508	87.8	40.87				
	457	87.8	35.38	G-18	457	136.9	36.60
B-18	457	80.4	36.17	G-15-b	381	208.3	*28.09
	457	77.4	36.53	G-15-a	381	154.8	29.18
	457	72.2	37.13				
B-15-b	381	105.7	30.10	G-15	381	108.6	30.20
				G-12-a	305	104.2	*23.06
B-15-a	381	95.2	29.24				
	381	80.4	30.48	G-12	305	81.9	*23.65
	381	68.5	29.62	G-10	254	65.5	*19.30
B-15	381	61.0	30.48	G-9	229	56.6	*17.07
	381	56.6	30.99				
B-12-a	305	53.6	24.56	G-8	203	48.4	*14.86
B-12	305	47.6	24.10				
	305	42.4	24.82				
B-10	254	42.4	19.48				
	254	35.0	20.40				

*Denotes that the value of D given is less than the distance center to center of beams when placed close together with flanges in contact.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED H-COLUMNS

The tables on pages 52-59 and 60-67, inclusive, give the dimensions, weights, areas and structural properties of the H-Column Sections for all the variations in size which are rolled.

The dimension T given in the tables is the nominal average thickness of the flange and is stated in even fractions of an inch, and nearest metric equivalents, for convenience.

The clear distance between the flange fillets is denoted by the dimension L , given in the tables, and is the depth of the flat surface of the web available for connections.

All columns having the same section number are from the same rolls. Thus all the sizes of 14-inch H-Columns tabulated on pages 52-53 and 60-61 are produced by the same rolls, the variations in dimensions of the series of sections being formed by the proportionate separation of the horizontal and vertical rolls.

In selecting columns it is advisable wherever possible to secure the desired range of size, from minimum to maximum, by confining the selection to columns having the same section number, as all the columns can then be secured from the same rolling.

The moment of inertia, section modulus and radius of gyration are given around both axes for all columns. The section modulus around the axis XX may be used to determine the transverse strength, in case it is desired to use the column sections as beams. The coefficient of strength for such purpose may be obtained in the following manner:

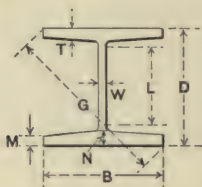
$$C = \frac{2}{3} fS,$$

where f = allowed fiber stress in pounds per square inch, and S = the section modulus.

The section modulus is also of use where columns are subject to bending due to eccentric loading. The use of the radius of gyration is explained on page 92, in connection with the tables of strength of columns.

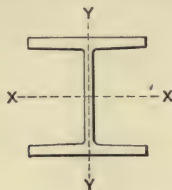
Typical connections and splices for H-Columns are shown on page 157, from which the simplicity of detail and the small amount of fabrication required for these columns are apparent.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS



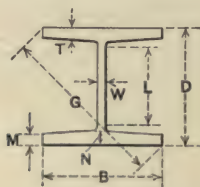
Section Number	Weight of Section, Pounds per Foot	Dimensions in Inches							
		D	Nominal T	B	W	M	N	G	L
H-14	83.5	13 ³ / ₄	1 ¹ / ₁₆	13.92	.43	.620	.755	19 ⁵ / ₈	L is constant = 11.06 inches
	91.0	13 ⁷ / ₈	3 ³ / ₄	13.96	.47	.683	.817	19 ³ / ₄	
	99.0	14	13 ¹ / ₁₆	14.00	.51	.745	.880	19 ¹³ / ₁₆	
	106.5	14 ¹ / ₈	7 ⁷ / ₈	14.04	.55	.808	.942	19 ¹⁵ / ₁₆	
	114.5	14 ¹ / ₄	15 ¹ / ₁₆	14.08	.59	.870	1.005	20 ¹ / ₁₆	
	122.5	14 ³ / ₈	1	14.12	.63	.933	1.067	20 ³ / ₁₆	
	130.5	14 ¹ / ₂	1 ¹ / ₁₆	14.16	.67	.995	1.130	20 ¹ / ₄	
	138.0	14 ⁵ / ₈	1 ¹ / ₈	14.19	.70	1.058	1.192	20 ³ / ₈	
	146.0	14 ³ / ₄	1 ³ / ₁₆	14.23	.74	1.120	1.255	20 ¹ / ₂	
	154.0	14 ⁷ / ₈	1 ¹ / ₄	14.27	.78	1.183	1.317	20 ⁵ / ₈	
	162.0	15	1 ⁵ / ₁₆	14.31	.82	1.245	1.380	20 ³ / ₄	
	170.5	15 ¹ / ₈	1 ³ / ₈	14.35	.86	1.308	1.442	20 ⁷ / ₈	
	178.5	15 ¹ / ₄	1 ⁷ / ₁₆	14.39	.90	1.370	1.505	21	
	186.5	15 ³ / ₈	1 ¹ / ₂	14.43	.94	1.433	1.567	21 ¹ / ₈	
	195.0	15 ¹ / ₂	1 ⁹ / ₁₆	14.47	.98	1.495	1.630	21 ¹ / ₄	
	203.5	15 ⁵ / ₈	1 ⁵ / ₈	14.51	1.02	1.558	1.692	21 ³ / ₈	
	211.0	15 ³ / ₄	1 ¹¹ / ₁₆	14.54	1.05	1.620	1.755	21 ⁷ / ₁₆	
	219.5	15 ⁷ / ₈	1 ³ / ₄	14.58	1.09	1.683	1.817	21 ⁹ / ₁₆	
	227.5	16	1 ¹³ / ₁₆	14.62	1.13	1.745	1.880	21 ¹¹ / ₁₆	
	236.0	16 ¹ / ₈	1 ⁷ / ₈	14.66	1.17	1.808	1.942	21 ¹³ / ₁₆	
	244.5	16 ¹ / ₄	1 ¹⁵ / ₁₆	14.70	1.21	1.870	2.005	21 ¹⁵ / ₁₆	
	253.0	16 ³ / ₈	2	14.74	1.25	1.933	2.067	22 ¹ / ₁₆	
	261.5	16 ¹ / ₂	2 ¹ / ₁₆	14.78	1.29	1.995	2.130	22 ³ / ₁₆	
	270.0	16 ⁵ / ₈	2 ¹ / ₈	14.82	1.33	2.058	2.192	22 ⁷ / ₁₆	
	278.5	16 ³ / ₄	2 ³ / ₁₆	14.86	1.37	2.120	2.255	22 ⁹ / ₁₆	
	287.5	16 ⁷ / ₈	2 ¹ / ₄	14.90	1.41	2.183	2.317	22 ¹¹ / ₁₆	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS



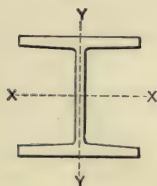
Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY			Section Number
		Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I'	Section Modulus S'	Radius of Gyration, Inches r'	
83.5	21.46	884.9	128.7	6.01	294.5	42.3	3.47	H-14
91.0	26.76	976.8	140.8	6.04	325.4	46.6	3.49	
99.0	29.06	1070.6	153.0	6.07	356.9	51.0	3.50	
106.5	31.38	1166.6	165.2	6.10	387.8	55.2	3.52	
114.5	33.70	1264.5	177.5	6.13	420.3	59.7	3.53	
122.5	36.04	1364.6	189.9	6.16	453.4	64.2	3.55	
130.5	38.38	1466.7	202.3	6.18	486.9	68.8	3.56	
138.0	40.59	1568.4	214.5	6.21	519.7	73.3	2.58	
146.0	42.95	1674.7	227.1	6.24	554.4	77.9	3.59	
154.0	45.33	1783.3	239.8	6.27	589.5	82.6	3.61	
162.0	47.71	1894.0	252.5	6.30	626.1	87.5	3.62	
170.5	50.11	2007.0	265.4	6.33	662.3	92.3	3.64	
178.5	52.51	2122.3	278.3	6.36	699.0	97.2	2.65	
186.5	54.92	2239.8	291.4	6.39	736.3	102.1	3.66	
195.0	57.35	2359.7	304.5	6.41	774.2	107.0	3.68	
203.5	59.78	2481.9	317.7	6.44	812.6	112.0	3.69	
211.0	62.07	2603.3	330.6	6.48	849.8	116.9	3.70	
219.5	64.52	2730.2	344.0	6.51	889.3	122.0	3.71	
227.5	66.98	2859.6	357.5	6.53	929.4	127.1	3.72	
236.0	69.45	2991.5	371.0	6.56	970.0	132.3	3.74	
244.5	71.94	3125.8	384.7	6.59	1011.3	137.6	3.75	
253.0	74.43	3262.7	398.5	6.62	1053.2	142.9	3.76	
261.5	76.93	3402.1	412.4	6.65	1095.6	148.3	3.77	
270.0	79.44	3544.1	426.4	6.68	1138.7	153.7	3.79	
278.5	81.97	3688.8	440.5	6.71	1182.4	159.1	3.80	
287.5	84.50	3836.1	454.7	6.74	1226.7	164.7	3.81	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS



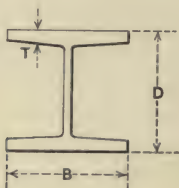
Section Number	Weight of Section, Pounds per Foot	Dimensions in Inches							
		D	Nominal T	B	W	M	N	G	L
H-12	64.5	11 $\frac{3}{4}$	$\frac{5}{8}$	11.92	.39	.567	.683	16 $\frac{3}{4}$	L is constant = 9.21 inches
	71.5	11 $\frac{7}{8}$	1 $\frac{1}{16}$	11.96	.43	.630	.745	16 $\frac{7}{8}$	
	78.0	12	$\frac{3}{4}$	12.00	.47	.692	.808	17	
	84.5	12 $\frac{1}{8}$	$\frac{13}{16}$	12.04	.51	.755	.870	17 $\frac{1}{8}$	
	91.5	12 $\frac{1}{4}$	$\frac{7}{8}$	12.08	.55	.817	.933	17 $\frac{1}{4}$	
	98.5	12 $\frac{3}{8}$	$\frac{15}{16}$	12.12	.59	.880	.995	17 $\frac{3}{8}$	
	105.0	12 $\frac{1}{2}$	1	12.16	.63	.942	1.058	17 $\frac{1}{2}$	
	112.0	12 $\frac{5}{8}$	1 $\frac{1}{16}$	12.20	.67	1.005	1.120	17 $\frac{5}{8}$	
	118.5	12 $\frac{3}{4}$	1 $\frac{1}{8}$	12.23	.70	1.067	1.183	17 $\frac{11}{16}$	
	125.5	12 $\frac{7}{8}$	1 $\frac{3}{8}$	12.27	.74	1.130	1.245	17 $\frac{13}{16}$	
	132.5	13	1 $\frac{1}{4}$	12.31	.78	1.192	1.308	17 $\frac{15}{16}$	
	139.5	13 $\frac{1}{8}$	1 $\frac{5}{16}$	12.35	.82	1.255	1.370	18	
	146.5	13 $\frac{1}{4}$	1 $\frac{3}{8}$	12.39	.86	1.317	1.433	18 $\frac{1}{8}$	
	153.5	13 $\frac{3}{8}$	1 $\frac{7}{16}$	12.43	.90	1.380	1.495	18 $\frac{1}{4}$	
	161.0	13 $\frac{1}{2}$	1 $\frac{1}{2}$	12.47	.94	1.442	1.558	18 $\frac{3}{8}$	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS



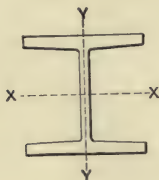
Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY			Section Number
		Moment of Inertia I	Section Modu- lus S	Radius of Gyra- tion, Inches r	Moment of Inertia I'	Section Modu- lus S'	Radius of Gyra- tion, Inches r'	
64.5	19.0	499.0	84.9	5.13	168.6	28.3	2.98	H-12
71.5	20.96	556.6	93.7	5.15	188.2	31.5	3.00	
78.0	22.94	615.6	102.6	5.18	208.1	34.7	3.01	
84.5	24.92	676.1	111.5	5.21	228.5	37.9	3.03	
91.5	26.92	738.1	120.5	5.24	249.2	41.3	3.04	
98.5	28.92	801.7	129.6	5.27	270.1	44.6	3.06	
105.0	30.94	866.8	138.6	5.30	291.7	48.0	3.07	
112.0	32.96	933.4	147.9	5.33	313.6	51.4	3.08	
118.5	34.87	1000.0	156.9	5.36	335.0	54.8	3.10	
125.5	36.91	1069.8	166.2	5.38	357.7	58.3	3.11	
132.5	38.97	1141.3	175.6	5.41	380.7	61.9	3.13	
139.5	41.03	1214.5	185.0	5.44	404.1	65.4	3.14	
146.5	43.10	1289.4	194.6	5.47	428.0	69.1	3.15	
153.5	45.19	1366.0	204.3	5.50	452.2	72.8	3.16	
161.0	47.28	1444.3	214.0	5.53	477.0	76.5	3.18	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS



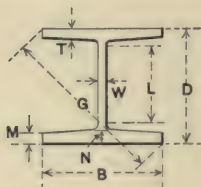
Section Number	Weight of Section, Pounds per Foot	Dimensions in Inches							
		D	Nominal T	B	W	M	N	G	L
H-10	49.0	9 ⁷ / ₈	9 ⁹ / ₁₆	9.97	.36	.514	.611	14 ¹ / ₁₆	L is constant = 7.67 inches
	54.0	10	5 ⁵ / ₈	10.00	.39	.577	.673	14 ³ / ₁₆	
	59.5	10 ¹ / ₈	11 ¹ / ₁₆	10.04	.43	.639	.736	14 ⁵ / ₁₆	
	65.5	10 ¹ / ₄	3 ³ / ₄	10.08	.47	.702	.798	14 ³ / ₈	
	71.0	10 ³ / ₈	13 ¹ / ₁₆	10.12	.51	.764	.861	14 ¹ / ₂	
	77.0	10 ¹ / ₂	7 ⁷ / ₈	10.16	.55	.827	.923	14 ⁵ / ₈	
	82.5	10 ⁵ / ₈	15 ¹ / ₁₆	10.20	.59	.889	.986	14 ³ / ₄	
	88.5	10 ³ / ₄	1	10.24	.63	.952	1.048	14 ⁷ / ₈	
	94.0	10 ⁷ / ₈	1 ¹ / ₁₆	10.28	.67	1.014	1.111	15	
	99.5	11	1 ¹ / ₈	10.31	.70	1.077	1.173	15 ¹ / ₈	
	105.5	11 ¹ / ₈	1 ³ / ₁₆	10.35	.74	1.139	1.236	15 ³ / ₁₆	
	111.5	11 ¹ / ₄	1 ¹ / ₄	10.39	.78	1.202	1.298	15 ⁵ / ₁₆	
	117.5	11 ³ / ₈	15 ¹ / ₁₆	10.43	.82	1.264	1.361	15 ⁷ / ₁₆	
	123.5	11 ¹ / ₂	1 ³ / ₈	10.47	.86	1.327	1.423	15 ⁹ / ₁₆	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS



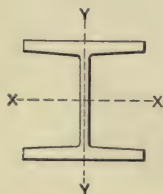
Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY			Section Number
		Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I'	Section Modulus S'	Radius of Gyration, Inches r'	
49.0	14.37	263.5	53.4	4.28	89.1	17.9	2.49	H-10
54.0	15.91	296.8	59.4	4.32	100.4	20.1	2.51	
59.5	17.57	331.9	65.6	4.35	112.2	22.3	2.53	
65.5	19.23	368.0	71.8	4.37	124.2	24.6	2.54	
71.0	20.91	405.2	78.1	4.40	136.5	27.0	2.56	
77.0	22.59	443.6	84.5	4.43	149.1	29.4	2.57	
82.5	24.29	483.0	90.9	4.46	162.0	31.8	2.58	
88.5	25.99	523.5	97.4	4.49	175.1	34.2	2.60	
94.0	27.71	565.2	103.9	4.52	188.6	36.7	2.61	
99.5	29.32	607.0	110.4	4.55	201.7	39.1	2.62	
105.5	31.06	651.0	117.0	4.58	215.6	41.7	2.64	
111.5	32.80	696.2	123.8	4.61	229.9	44.3	2.65	
117.5	34.55	742.7	130.6	4.64	244.4	46.9	2.66	
123.5	36.32	790.4	137.5	4.67	259.3	49.5	2.67	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS



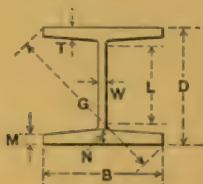
Section Number	Weight of Section, Pounds per Foot	Dimensions in Inches							
		D	Nominal T	B	W	M	N	G	L
H-8	32.0	7 ⁷ / ₈	7 ¹ / ₁₆	8.00	.31	.399	.476	11 ¹ / ₄	L is constant = 6.14 inches
	34.5	8	1 ¹ / ₂	8.00	.31	.462	.538	11 ³ / ₈	
	39.0	8 ¹ / ₈	9 ¹ / ₁₆	8.04	.35	.524	.601	11 ⁷ / ₁₆	
	43.5	8 ¹ / ₄	5 ⁵ / ₈	8.08	.39	.587	.663	11 ⁹ / ₁₆	
	48.0	8 ³ / ₈	11 ¹ / ₁₆	8.12	.43	.649	.726	11 ¹¹ / ₁₆	
	53.0	8 ¹ / ₂	3 ³ / ₄	8.16	.47	.712	.788	11 ¹³ / ₁₆	
	57.5	8 ⁵ / ₈	13 ¹ / ₁₆	8.20	.51	.774	.851	12	
	62.0	8 ³ / ₄	7 ⁷ / ₈	8.24	.55	.837	.913	12 ¹ / ₁₆	
	67.0	8 ⁷ / ₈	15 ¹ / ₁₆	8.28	.59	.899	.976	12 ¹ / ₈	
	71.5	9	1	8.32	.63	.962	1.038	12 ¹ / ₄	
	76.5	9 ¹ / ₈	1 ¹ / ₁₆	8.36	.67	1.024	1.101	12 ³ / ₈	
	81.0	9 ¹ / ₄	1 ¹ / ₈	8.39	.70	1.087	1.163	12 ¹ / ₂	
	85.5	9 ³ / ₈	1 ³ / ₁₆	8.43	.74	1.149	1.226	12 ⁵ / ₈	
	90.5	9 ¹ / ₂	1 ¹ / ₄	8.47	.78	1.212	1.288	12 ³ / ₄	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS



Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY			
		Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I'	Section Modulus S'	Radius of Gyration, Inches r'	Section Number
32.0	9.17	105.7	26.9	3.40	35.8	8.9	1.98	H-8
34.5	10.17	121.5	30.4	3.46	41.1	10.3	2.01	
39.0	11.50	139.5	34.3	3.48	47.2	11.7	2.03	
43.5	12.83	158.3	38.4	3.51	53.4	13.2	2.04	
48.0	14.18	177.7	42.4	3.54	59.8	14.7	2.05	
53.0	15.53	197.8	46.5	3.57	66.3	16.3	2.07	
57.5	16.90	218.6	50.7	3.60	73.1	17.8	2.08	
62.0	18.27	240.2	54.9	3.63	80.0	19.4	2.09	
67.0	19.66	262.5	59.2	3.65	87.1	21.0	2.11	
71.5	21.05	285.6	63.5	3.68	94.4	22.7	2.12	
76.5	22.46	309.5	67.8	3.71	101.9	24.4	2.13	
81.0	23.78	333.5	72.1	3.75	109.2	26.0	2.14	
85.5	25.20	359.0	76.6	3.77	117.2	27.8	2.16	
90.5	26.64	385.3	81.1	3.80	125.1	29.6	2.17	

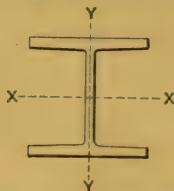
DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS



Number of Section	Weight per Meter, Kilo-grams	Weight per Foot, Pounds	Dimensions in Millimeters						
			D	T	B	W	M	N	G
H-14	124.3	83.5	350	17.6	354	11	15.9	19.3	497
	135.4	91.0	353	19.1	355	12	17.4	20.8	500
	147.3	99.0	356	20.6	356	13	18.9	22.3	503
	158.5	106.5	359	22.1	357	14	20.4	23.8	506
	170.4	114.5	362	23.6	358	15	21.9	25.3	509
	182.3	122.5	366	25.6	359	16	23.9	27.3	512
	194.2	130.5	369	27.1	360	17	25.4	28.8	515
	205.4	138.0	372	28.6	361	18	26.9	30.3	518
	217.3	146.0	375	30.1	362	19	28.4	31.8	521
	229.2	154.0	378	31.6	363	20	29.9	33.3	524
	241.1	162.0	381	33.1	364	21	31.4	34.8	527
	253.7	170.5	385	35.1	365	22	33.4	36.8	530
	265.6	178.5	388	36.6	366	23	34.9	38.3	533
	277.5	186.5	391	38.1	367	24	36.4	39.8	536
	290.2	195.0	394	39.6	368	25	37.9	41.3	539
	302.8	203.5	397	41.1	369	26	39.4	42.8	542
	314.0	211.0	401	43.1	370	27	41.4	44.8	544
	326.7	219.5	404	44.6	371	28	42.9	46.3	547
	338.6	227.5	407	46.1	372	29	44.4	47.8	550
	351.2	236.0	410	47.6	373	30	45.9	49.3	554
	363.9	244.5	413	49.1	374	31	47.4	50.8	557
	376.5	253.0	416	50.6	375	32	48.9	52.3	560
	389.2	261.5	420	52.6	376	33	50.9	54.3	563
	401.8	270.0	423	54.1	377	34	52.4	55.8	566
	414.5	278.5	426	55.6	378	35	53.9	57.3	569
	427.9	287.5	429	57.1	379	36	55.4	58.8	572

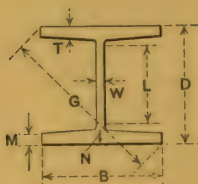
The dimension L is constant = 281 millimeters.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS



Weight per Meter	Area of Section	Axis XX			Axis YY			Num- ber of Sec- tion
		Moment of Inertia	Modu- lus of Section	Radius of Gya- tion	Moment of Inertia	Modu- lus of Section	Radius of Gya- tion	
		I	S	r	I'	S'	r'	
Kg.	Cm. ²	Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.	
124.3	157.8	36,833	2,109	15.27	12,258	693	8.81	
135.4	172.6	40,658	2,307	15.34	13,544	764	8.86	
147.3	187.5	44,562	2,507	15.42	14,855	836	8.89	
158.5	202.5	48,558	2,707	15.49	16,142	905	8.94	
170.4	217.4	52,633	2,909	15.57	17,494	978	8.97	
182.3	232.5	56,799	3,112	15.65	18,872	1,052	9.02	
194.2	247.6	61,049	3,315	15.70	20,266	1,127	9.04	
205.4	261.9	65,282	3,515	15.77	21,632	1,201	9.09	
217.3	277.1	69,707	3,722	15.85	23,076	1,277	9.12	
229.2	292.5	74,227	3,930	15.93	24,537	1,354	9.17	
241.1	307.8	78,835	4,138	16.00	26,060	1,434	9.19	
253.7	323.3	83,538	4,349	16.08	27,567	1,513	9.25	
265.6	338.8	88,338	4,561	16.15	29,095	1,593	9.27	H-14
277.5	354.3	93,228	4,775	16.23	30,647	1,673	9.30	
290.2	370.0	98,219	4,990	16.28	32,225	1,753	9.35	
302.8	385.7	103,305	5,206	16.36	33,823	1,835	9.37	
314.0	400.5	108,358	5,418	16.46	35,372	1,916	9.40	
326.7	416.3	113,640	5,637	16.54	37,016	1,999	9.42	
338.6	432.1	119,027	5,858	16.59	38,685	2,083	9.45	
351.2	448.1	124,517	6,080	16.66	40,375	2,168	9.50	
363.9	464.1	130,107	6,304	16.74	42,094	2,255	9.53	
376.5	480.2	135,805	6,530	16.81	43,838	2,342	9.55	
389.2	496.3	141,607	6,758	16.89	45,603	2,430	9.58	
401.8	512.5	147,518	6,988	16.97	47,397	2,519	9.63	
414.5	528.8	153,541	7,219	17.04	49,216	2,607	9.65	
427.9	545.2	159,672	7,451	17.12	51,060	2,699	9.68	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS



Number of Section	Weight per Meter, Kilograms	Weight per Foot, Pounds	Dimensions in Millimeters						
			D	T	B	W	M	N	G
H-12	96.0	64.5	299	16.1	303	10	14.6	17.6	425
	106.4	71.5	302	17.6	304	11	16.1	19.1	428
	116.1	78.0	305	19.1	305	12	17.6	20.6	431
	125.8	84.5	308	20.6	306	13	19.1	22.1	434
	136.2	91.5	311	22.1	307	14	20.6	23.6	437
	146.6	98.5	314	23.6	308	15	22.1	25.1	440
	156.3	105.0	318	25.6	309	16	24.1	27.1	443
	166.7	112.0	321	27.1	310	17	25.6	28.6	446
	176.4	118.5	324	28.6	311	18	27.1	30.1	449
	186.8	125.5	327	30.1	312	19	28.6	31.6	452
	197.2	132.5	330	31.6	313	20	30.1	33.1	455
	207.6	139.5	333	33.1	314	21	31.6	34.6	458
	218.0	146.5	337	35.1	315	22	33.6	36.6	461
	228.4	153.5	340	36.6	316	23	35.1	38.1	464
	239.6	161.0	343	38.1	317	24	36.6	39.6	467

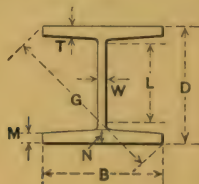
The dimension L is constant = 234 millimeters.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS



Weight per Meter	Area of Section	Axis XX			Axis YY			Num- ber of Sec- tion
		Moment of Inertia	Modu- lus of Section	Radius of Gyra- tion	Moment of Inertia	Modu- lus of Section	Radius of Gyra- tion	
		I	S	r	I'	S'	r'	
Kg.	Cm. ²	Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.	
96.0	122.6	20,770	1,391	13.03	7,018	464	7.57	H-12
106.4	135.2	23,168	1,535	13.08	7,834	516	7.62	
116.1	148.0	25,623	1,681	13.16	8,662	569	7.65	
125.8	160.8	28,142	1,827	13.23	9,511	621	7.70	
136.2	173.7	30,722	1,975	13.31	10,373	677	7.72	
146.6	186.6	33,370	2,124	13.39	11,243	731	7.77	
156.3	199.6	36,079	2,271	13.46	12,142	787	7.80	
166.7	212.6	38,851	2,424	13.54	13,053	842	7.82	
176.4	225.0	41,624	2,571	13.61	13,944	898	7.87	
186.8	238.1	44,529	2,724	13.67	14,889	955	7.90	
197.2	251.4	47,505	2,878	13.74	15,846	1,014	7.95	
207.6	264.7	50,552	3,032	13.82	16,820	1,072	7.98	
218.0	278.1	53,669	3,189	13.89	17,815	1,132	8.00	
228.4	291.5	56,858	3,348	13.97	18,822	1,193	8.03	
239.6	305.0	60,117	3,507	14.05	19,854	1,254	8.08	

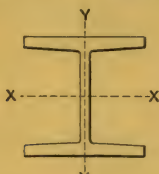
DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS



Num- ber of Sec- tion	Weight per Meter, Kilo- grams	Weight per Foot, Pounds	Dimensions in Millimeters						
			D	T	B	W	M	N	G
H-10	72.9	49.0	251	14.4	253	9	13.2	15.6	356
	80.4	54.0	254	15.9	254	10	14.7	17.1	359
	88.5	59.5	257	17.4	255	11	16.2	18.6	362
	97.5	65.5	260	18.9	256	12	17.7	20.1	365
	105.7	71.0	263	20.4	257	13	19.2	21.6	368
	114.6	77.0	267	22.4	258	14	21.2	23.6	371
	122.8	82.5	270	23.9	259	15	22.7	25.1	374
	131.7	88.5	273	25.4	260	16	24.2	26.6	377
	139.9	94.0	276	26.9	261	17	25.7	28.1	380
	148.1	99.5	279	28.4	262	18	27.2	29.6	383
	157.0	105.5	283	30.4	263	19	29.2	31.6	386
	165.9	111.5	286	31.9	264	20	30.7	33.1	389
	174.9	117.5	289	33.4	265	21	32.2	34.6	392
	183.8	123.5	292	34.9	266	22	33.7	36.1	395

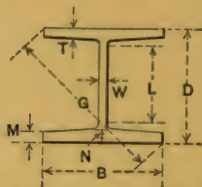
The dimension L is constant = 195 millimeters.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS



Weight per Meter	Area of Section	Axis XX			Axis YY			Num- ber of Sec- tion
		Moment of Inertia	Modu- lus of Section	Radius of Gyr- ation	Moment of Inertia	Modu- lus of Section	Radius of Gyr- ation	
		I	S	r	I'	S'	r'	
Kg.	Cm. ²	Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.	
72.9	92.7	10,968	875	10.87	3,709	293	6.32	
80.4	102.6	12,354	973	10.97	4,179	329	6.38	
88.5	113.4	13,815	1,075	11.05	4,670	365	6.43	
97.5	124.1	15,317	1,177	11.10	5,170	403	6.45	
105.7	134.9	16,866	1,280	11.18	5,682	442	6.50	
114.6	145.7	18,464	1,385	11.25	6,206	482	6.53	
122.8	156.7	20,104	1,490	11.33	6,743	521	6.55	
131.7	167.7	21,790	1,596	11.40	7,288	560	6.60	H-10
139.9	178.8	23,526	1,703	11.48	7,850	601	6.63	
148.1	189.2	25,265	1,809	11.56	8,395	641	6.65	
157.0	200.4	27,097	1,917	11.63	8,974	683	6.71	
165.9	211.6	28,978	2,029	11.71	9,569	726	6.73	
174.9	222.9	30,914	2,140	11.79	10,173	769	6.76	
183.8	234.3	32,899	2,253	11.86	10,793	811	6.78	

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS



Number of Section	Weight per Meter, Kilograms	Weight per Foot, Pounds	Dimensions in Millimeters						
			D	T	B	W	M	N	G
H-8	47.6	32.0	200	11.2	203	8	10.2	12.2	285
	51.3	34.5	203	12.7	203	8	11.7	13.7	287
	58.0	39.0	206	14.2	204	9	13.2	15.2	290
	64.7	43.5	209	15.7	205	10	14.7	16.7	293
	71.4	48.0	213	17.7	206	11	16.7	18.7	296
	78.9	53.0	216	19.2	207	12	18.2	20.2	299
	85.6	57.5	219	20.7	208	13	19.7	21.7	302
	92.3	62.0	222	22.2	209	14	21.2	23.2	305
	99.7	67.0	225	23.7	210	15	22.7	24.7	308
	106.4	71.5	228	25.2	211	16	24.2	26.2	311
	113.8	76.5	232	27.2	212	17	26.2	28.2	314
	120.5	81.0	235	28.7	213	18	27.7	29.7	317
	127.2	85.5	238	30.2	214	19	29.2	31.2	320
	134.7	90.5	241	31.7	215	20	30.7	32.7	323

The dimension L is constant = 156 millimeters.

DIMENSIONS AND PROPERTIES OF BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS



Weight per Meter	Area of Section	Axis XX			Axis YY			Num- ber of Sec- tion
		Moment of Inertia	Modu- lus of Section	Radius of Gyra- tion	Moment of Inertia	Modu- lus of Section	Radius of Gyra- tion	
		I	S	r	I'	S'	r'	
Kg.	Cm. ²	Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.	
47.6	59.2	4,400	441	8.64	1,490	146	5.03	H-8
51.3	65.6	5,057	498	8.79	1,711	169	5.11	
58.0	74.2	5,806	562	8.84	1,965	192	5.16	
64.7	82.8	6,589	629	8.92	2,223	216	5.18	
71.4	91.5	7,396	695	8.99	2,489	241	5.21	
78.9	100.2	8,233	762	9.07	2,760	267	5.26	
85.6	109.0	9,099	831	9.14	3,043	292	5.28	
92.3	117.9	9,998	900	9.22	3,330	318	5.31	
99.7	126.8	10,926	970	9.27	3,625	344	5.36	
106.4	135.8	11,888	1,041	9.35	3,929	372	5.38	
113.8	144.9	12,882	1,111	9.42	4,241	400	5.41	
120.5	153.4	13,881	1,182	9.53	4,545	426	5.44	
127.2	162.6	14,943	1,255	9.58	4,878	456	5.49	
134.7	171.9	16,038	1,329	9.65	5,207	485	5.51	

BETHLEHEM 14-INCH SPECIAL SECTION ROLLED STEEL H-COLUMN

When columns are required of greater sectional area than the regular sections of H-columns, it is necessary to build a compound section to obtain the desired area. This may be the case in the columns for the lower stories of a high building.

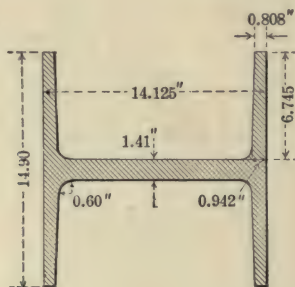
Additional area may be secured by riveting plates to the flanges of the regular H-columns, but the drilling of the holes for attaching such plates may be objectionable, on account of the thick metal in the flanges of the heavy H-columns. The 14-inch special section is designed to match the regular 14-inch H-columns, and permits the addition of plates, or other shapes, for increasing the area to the desired extent, avoiding the drilling of thick metal in the flanges.

Dimensions and properties of this special section are given on pages 69 and 74. The section is produced by the same rolls and has the same inner contour as the series of 14-inch H-columns on pages 52-53 and 60-61. If the largest regular 14-inch H-column does not provide the required area, the special section can be used and increased in area to the desired amount, in the manner indicated by Figs. 1-3 on pages 69 and 74. This may be necessary for the heavy columns required in the lower stories of a high building. The regular series of 14-inch H-columns can then be used in the upper stories, where they provide sufficient area. The regular 14-inch H-columns can be spliced to the special section in the usual way.

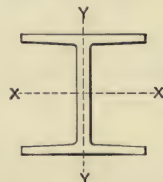
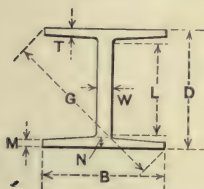
Properties of Compound Columns, similar to Fig. 1, are given on pages 70-71 and 72-73 and safe loads in the tables on pages 108-109 and 122-123.

H-14-b

148.0 Pounds



DIMENSIONS AND PROPERTIES OF BETHLEHEM 14-INCH SPECIAL SECTION ROLLED STEEL H-COLUMN



DIMENSIONS

Section Number	Weight of Section. Pounds per Foot	Dimensions in Inches							
		D	Nominal T	B	W	M	N	G	L
H-14-b	148.0	14 $\frac{1}{8}$	$\frac{7}{8}$	14.90	1.41	.808	.942	20 $\frac{7}{8}$	11.06

PROPERTIES

Section Number	Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY		
			Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I'	Section Modulus S'	Radius of Gyration, Inches r'
H-14-b	148.0	43.52	1368.5	193.8	5.61	468.6	62.9	3.28

Suggestions for Using the Special Section of H-Column in Building Up Columns of Large Sectional Area



Fig. 1



Fig. 2

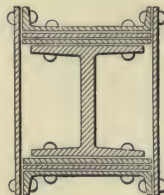
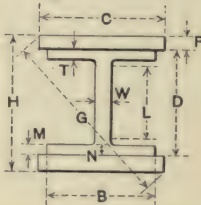


Fig. 3

DIMENSIONS AND PROPERTIES OF COMPOUND COLUMNS

14-inch x 148-pound
Special H-Section

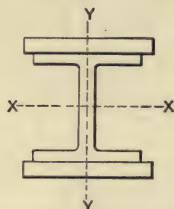


Reinforced
with Cover Plates

Section	Weight of Section, Pounds per Foot	Dimensions in Inches				
		Cover Plates		Depth of Column H	Diagonal Diameter G	Dimensions of 14-inch Special H-Section
		Width C	Thickness P			
Columns composed of a 14-inch x 148-pound Special Column Section (Section H-14-b), reinforced with cover plates of width and thickness given in table. The total thickness, P, may be made of two or more plates, each of punchable thickness.	284.0	16	1 1/4	16 5/8	23 1/16	D 14 1/8
	290.8	16	1 5/16	16 3/4	23 3/16	
	297.6	16	1 3/8	16 7/8	23 1/4	
	304.4	16	1 7/16	17	23 3/8	
	311.2	16	1 1/2	17 1/8	23 1/16	
	318.0	16	1 9/16	17 1/4	23 1/2	T 7/8
	324.8	16	1 5/8	17 3/8	23 5/8	
	331.6	16	1 11/16	17 1/2	23 11/16	
	338.4	16	1 3/4	17 5/8	23 13/16	B 14.90
	345.2	16	1 13/16	17 3/4	23 7/8	
	350.3	17	1 3/4	17 5/8	24 1/2	
	357.5	17	1 13/16	17 3/4	24 9/16	W 1.41
	364.7	17	1 7/8	17 7/8	24 11/16	
	372.0	17	1 15/16	18	24 3/4	
	379.2	17	2	18 1/8	24 7/8	M 0.808
	386.4	17	2 1/16	18 1/4	24 15/16	
	393.6	17	2 1/8	18 3/8	25 1/16	
	400.9	17	2 3/16	18 1/2	25 5/8	N 0.942
	408.1	17	2 1/4	18 5/8	25 3/16	
	415.3	17	2 5/16	18 3/4	25 5/16	
	423.4	18	2 1/4	18 5/8	25 7/8	L 11.06
	431.0	18	2 5/16	18 3/4	26	
	438.7	18	2 3/8	18 7/8	26 1/16	
	446.3	18	2 7/16	19	26 9/16	
	454.0	18	2 1/2	19 1/8	26 1/4	
	461.6	18	2 9/16	19 1/4	26 3/8	
	469.3	18	2 5/8	19 3/8	26 7/16	
	476.9	18	2 11/16	19 1/2	26 9/16	
	484.6	18	2 3/4	19 5/8	26 5/8	

DIMENSIONS AND PROPERTIES OF COMPOUND COLUMNS

14-inch x 148-pound
Special H-Section

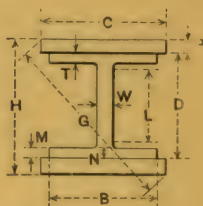


Reinforced
with Cover Plates

Weight of Section, Pounds per Foot	Area of Section, Square Inches	Axis XX			Axis YY			Cover Plates	
		Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I'	Section Modulus S'	Radius of Gyration, Inches r'	Width in Inches C	Thickness, Inches P
284.0	83.52	3737.7	449.6	6.69	1321.9	165.2	3.98	16	1 1/4
290.8	85.52	3876.9	462.9	6.73	1364.6	170.6	3.99	16	1 5/16
297.6	87.52	4018.2	476.2	6.78	1407.3	175.9	4.01	16	1 3/8
304.4	89.52	4161.7	489.6	6.82	1449.9	181.2	4.02	16	1 7/16
311.2	91.52	4307.2	503.0	6.86	1492.6	186.6	4.04	16	1 1/2
318.0	93.52	4454.9	516.5	6.90	1535.3	191.9	4.05	16	1 9/16
324.8	95.52	4604.8	530.0	6.94	1577.9	197.2	4.06	16	1 5/8
331.6	97.52	4756.8	543.6	6.98	1620.6	202.6	4.08	16	1 11/16
338.4	99.52	4911.0	557.3	7.02	1663.3	207.9	4.09	16	1 3/4
345.2	101.52	5067.5	571.0	7.07	1705.9	213.2	4.10	16	1 13/16
350.3	103.02	5132.5	582.4	7.06	1901.6	223.7	4.30	17	1 3/4
357.5	105.15	5298.7	597.0	7.10	1952.8	229.7	4.31	17	1 13/16
364.7	107.27	5467.2	611.7	7.14	2003.9	235.8	4.32	17	1 7/8
372.0	109.40	5638.1	626.5	7.18	2055.1	241.8	4.33	17	1 15/16
379.2	111.52	5811.5	641.3	7.22	2106.3	247.8	4.35	17	2
386.4	113.65	5987.2	656.1	7.26	2157.5	253.8	4.36	17	2 1/16
393.6	115.77	6165.4	671.1	7.30	2208.7	259.8	4.37	17	2 1/8
400.9	117.90	6345.9	686.0	7.34	2259.8	265.9	4.38	17	2 3/16
408.1	120.02	6529.0	701.1	7.38	2311.0	271.9	4.39	17	2 1/4
415.3	122.15	6714.5	716.2	7.41	2362.2	277.9	4.40	17	2 5/16
423.4	124.52	6832.6	733.7	7.41	2655.6	295.1	4.62	18	2 1/4
431.0	126.77	7029.0	749.8	7.45	2716.4	301.8	4.63	18	2 5/16
438.7	129.02	7228.1	765.9	7.48	2777.1	308.6	4.64	18	2 3/8
446.3	131.27	7429.8	782.1	7.52	2837.9	315.3	4.65	18	2 7/16
454.0	133.52	7634.2	798.3	7.56	2898.6	322.1	4.66	18	2 1/2
461.6	135.77	7841.3	814.7	7.60	2959.4	328.8	4.67	18	2 9/16
469.3	138.02	8051.1	831.1	7.64	3020.1	335.6	4.68	18	2 5/8
476.9	140.27	8263.6	847.6	7.68	3080.9	342.3	4.69	18	2 11/16
484.6	142.52	8478.9	864.1	7.71	3141.6	349.1	4.70	18	2 3/4

DIMENSIONS AND PROPERTIES OF COMPOUND COLUMNS

H-14-b x 220.3-kilogram
Special H-Section

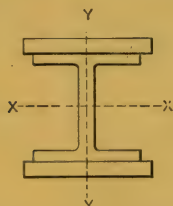


Reinforced
with Cover Plates

Section	Weight per Meter	Weight per Foot	Dimensions in Millimeters				
			Cover plates		Depth of Column	Diagonal Diameter	Dimen- sions of H-14-b Special Section
			Width	Thickness			
	Kg.	Pounds	C	P	H	G	
Columns composed of a H-14-b x 220.3-kilogram Special Section, reinforced with cover plates of width and thickness given in the table. The total thickness, P, may be made of two or more plates, each of punchable thickness.	422.6	284.0	406	31.6	422	586	
	432.8	290.8	406	33.1	425	588	D
	442.9	297.6	406	35.1	429	591	358.8
	453.0	304.4	406	36.6	432	593	
	463.1	311.2	406	38.1	435	595	T
	473.2	318.0	406	39.6	438	598	22.2
	483.4	324.8	406	41.1	441	600	
	493.5	331.6	406	43.1	445	602	B
	503.6	338.4	406	44.6	448	605	378.5
	513.7	345.2	406	46.1	451	607	
	521.3	350.3	432	44.6	448	622	
	532.0	357.5	432	46.1	451	624	W
	542.7	364.7	432	47.6	454	627	35.8
	553.6	372.0	432	49.1	457	629	
	564.3	379.2	432	50.6	460	631	
	575.0	386.4	432	52.6	464	634	
	585.8	393.6	432	54.1	467	636	M
	596.6	400.9	432	55.6	470	638	20.5
	607.3	408.1	432	57.1	473	641	
	618.0	415.3	432	58.6	476	643	
	630.1	423.4	457	57.1	473	658	
	641.4	431.0	457	58.6	476	660	N
	652.9	438.7	457	60.1	479	662	23.9
	664.2	446.3	457	62.1	483	665	
	675.6	454.0	457	63.6	486	667	
	687.0	461.6	457	65.1	489	669	L
	698.4	469.3	457	66.6	492	672	280.9
	709.7	476.9	457	68.1	495	674	
	721.2	484.6	457	69.6	498	676	

DIMENSIONS AND PROPERTIES OF COMPOUND COLUMNS

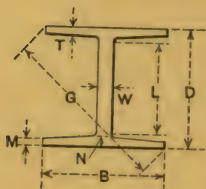
H-14-b x 220.3-kilogram
Special H-Section



Reinforced
with Cover Plates

Weight per Meter	Area of Section	Axis XX			Axis YY		
		Moment of Inertia	Modulus of Section	Radius of Gyrations	Moment of Inertia	Modulus of Section	Radius of Gyrations
		I	S	r	I'	S'	r'
Kg.	Cm. ²	Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.
422.6	538.8	155,576	7,368	16.99	55,022	2,707	10.11
432.8	551.7	161,370	7,586	17.09	56,799	2,796	10.14
442.9	564.6	167,252	7,804	17.22	58,577	2,883	10.19
453.0	577.5	173,225	8,023	17.32	60,350	2,969	10.21
463.1	590.5	179,281	8,243	17.42	62,127	3,058	10.26
473.2	603.4	185,429	8,464	17.53	63,905	3,145	10.29
483.4	616.3	191,668	8,685	17.63	65,678	3,232	10.31
493.5	629.2	197,995	8,908	17.73	67,455	3,220	10.36
503.6	642.1	204,413	9,133	17.83	69,232	3,407	10.39
513.7	655.0	210,927	9,357	17.96	71,006	3,494	10.41
521.3	664.6	213,633	9,544	17.93	79,151	3,666	10.92
532.0	678.4	220,550	9,783	18.03	81,282	3,764	10.95
542.7	692.1	227,564	10,024	18.14	83,409	3,864	10.97
553.6	705.8	234,677	10,267	18.24	85,540	3,962	11.00
564.3	719.5	241,895	10,509	18.34	87,672	4,061	11.05
575.0	733.2	249,208	10,752	18.44	89,803	4,159	11.07
585.8	746.9	256,626	10,997	18.54	91,934	4,257	11.10
596.6	760.6	264,139	11,242	18.64	94,061	4,357	11.13
607.3	774.3	271,760	11,489	18.75	96,192	4,456	11.15
618.0	788.1	279,481	11,737	18.82	98,323	4,554	11.18
630.1	803.4	284,397	12,023	18.82	110,535	4,836	11.73
641.4	817.9	292,572	12,287	18.92	113,066	4,946	11.76
652.9	832.4	300,859	12,551	19.00	115,593	5,057	11.79
664.2	846.9	309,254	12,816	19.10	118,123	5,167	11.81
675.6	861.4	317,762	13,082	19.20	120,650	5,278	11.84
687.0	875.9	326,382	13,351	19.30	123,181	5,388	11.86
698.4	890.4	335,115	13,619	19.41	125,707	5,500	11.89
709.7	905.0	343,960	13,890	19.51	128,238	5,609	11.91
721.2	919.5	352,921	14,160	19.58	130,764	5,721	11.94

DIMENSIONS AND PROPERTIES OF BETHLEHEM 14-INCH SPECIAL SECTION ROLLED STEEL H-COLUMN



DIMENSIONS

Number of Section	Weight of Section, Kg. per Meter	Dimensions in Millimeters							
		D	T	B	W	M	N	G	L
H-14-b	220.3	358.8	22.2	378.5	35.8	20.5	23.9	521	280.9

PROPERTIES

Number of Section	Weight of Section, per Meter	Area of Section	Axis XX			Axis YY		
			Moment of Inertia	Section Modulus	Radius of Gyration	Moment of Inertia	Radius of Gyration	Section Modulus
			I	S	r	I'	S'	r'
			Cm. ⁴	Cm. ³	Cm.	Cm. ⁴	Cm. ³	Cm.
H-14-b	220.3	280.8	56,962	3,176	14.25	19,505	10.31	8.33

Suggestions for Using the Special Section of H-14-b Column in Building Up Columns of Large Sectional Area!



Fig. 1



Fig. 2

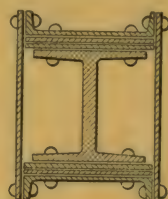
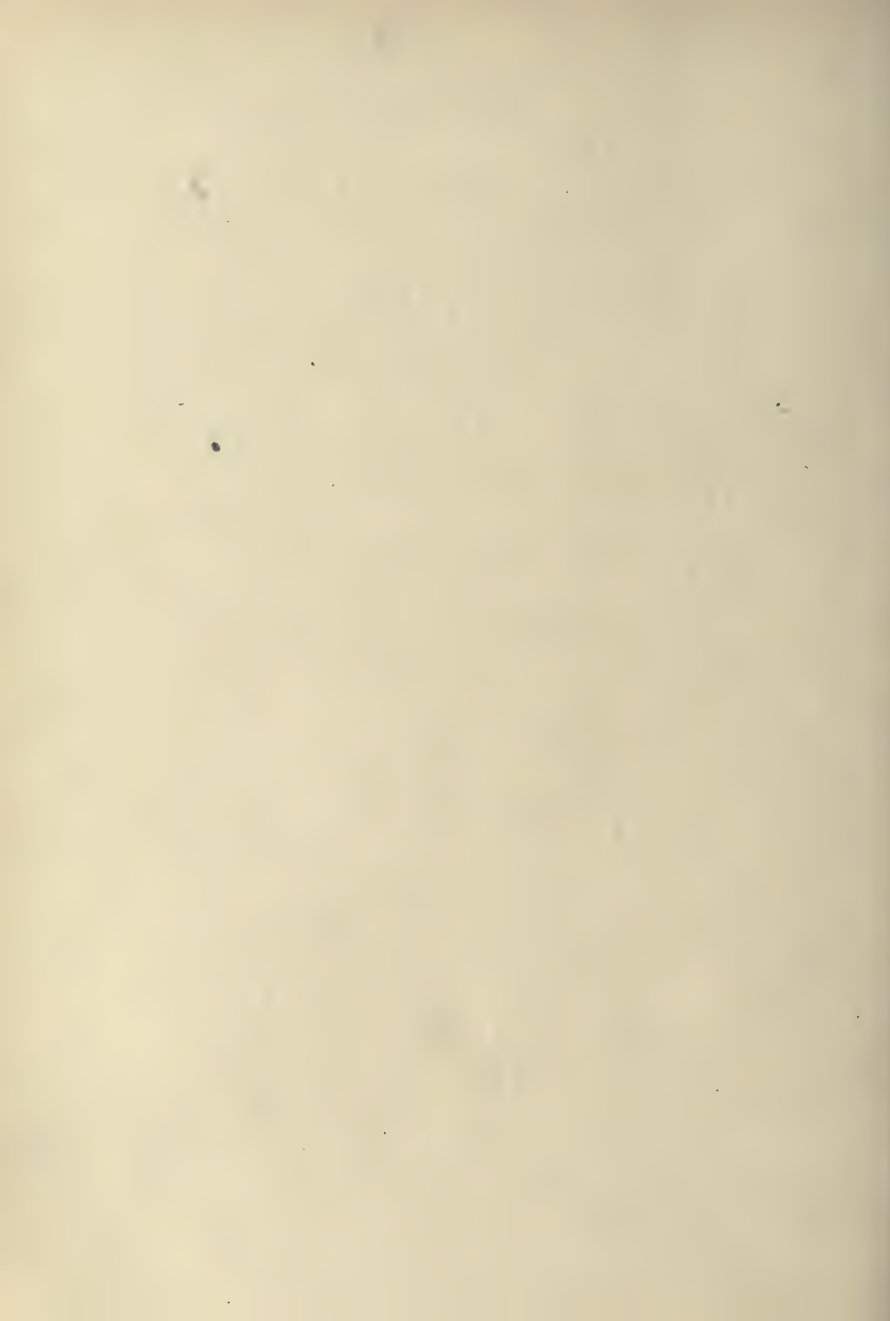


Fig. 3

SAFE LOADS
FOR
BETHLEHEM ROLLED GIRDER
AND I-BEAMS, H-COLUMNS,
GIRDER AND I-BEAMS
USED AS COLUMNS,
AND COMPOUND
COLUMNS

NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

Metric tables are printed on colored paper for convenience of reference.



SAFE UNIFORMLY DISTRIBUTED LOADS FOR BETHLEHEM I-BEAMS AND GIRDER BEAMS

The tables on pages 78-85 and 86-91 give the safe uniformly distributed loads, in tons of 2000 pounds and metric tons of 1000 kilograms, on Bethlehem Beams for a maximum fiber stress of 16,000 pounds per square inch and 1200 kilograms per square centimeter. The tabular loads include the weight of the beam, which must be deducted to obtain the net load a beam will support.

Safe loads for intermediate or heavier weights of beams can be obtained from the separate column of corrections, given for each size, which states the increase in safe load for each pound increase in weight per foot of beam.

If the load is concentrated at the center of the span, the safe load is one-half the safe uniformly distributed load for the same span.

The safe loads on short spans may be limited by the shearing strength of the web, instead of by the maximum fiber stress allowed in the flanges. This limit is indicated in the tables by heavy cross lines. The loads given above these lines are greater than the safe crippling strength of the web and must not be used unless the webs are stiffened. In such cases it will generally be advisable to select a heavier beam with a thicker web. Maximum safe shears for all beam and girder sections are given on pages 128 and 129.

It is assumed in the tables that the compression flanges of the beams are properly secured against yielding sideways. They should be held in position at distances not exceeding 20 times the width of the flange, otherwise the allowable safe loads must be reduced as per the following table:

BEAMS UNSUPPORTED SIDEWAYS

Unsupported Length of Beam	Greatest Safe Load	Unsupported Length of Beam	Greatest Safe Load
20 flange widths	Full tabular load	50 flange widths	$\frac{7}{10}$ tabular load
30 flange widths	$\frac{9}{10}$ tabular load	60 flange widths	$\frac{6}{10}$ tabular load
40 flange widths	$\frac{8}{10}$ tabular load	70 flange widths	$\frac{5}{10}$ tabular load

Bethlehem Beams, on account of their much wider flanges, will safely support greater loads than Standard Beams on long spans where the beams are without lateral support.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	30" G		Add for Each Pound Inc. in Weight	28" G	Add for Each Pound Inc. in Weight	26" G		Add for Each Pound Inc. in Weight
	G-30-a	G-30				G-26-a	G-26.	
	200 Pounds	180 Pounds		165 Pounds		160 Pounds	150 Pounds	
18	180.75	161.87	.44	138.89	.41	128.11	117.47	.38
19	171.24	153.35	.41	131.58	.39	121.37	111.29	.36
20	162.68	145.68	.39	125.00	.37	115.30	105.72	.34
21	154.93	138.74	.37	119.05	.35	109.81	100.69	.32
22	147.89	132.44	.36	113.64	.33	104.82	96.11	.31
23	141.46	126.68	.34	108.70	.32	100.26	91.93	.30
24	135.56	121.40	.33	104.17	.31	96.08	88.10	.28
25	130.14	116.55	.31	100.00	.29	92.24	84.58	.27
26	125.14	112.06	.30	96.16	.28	88.69	81.32	.26
27	120.50	107.91	.29	92.60	.27	85.41	78.31	.25
28	116.20	104.06	.28	89.29	.26	82.36	75.52	.24
29	112.19	100.47	.27	86.21	.25	79.52	72.91	.23
30	108.45	97.12	.26	83.34	.24	76.87	70.48	.23
31	104.95	93.99	.25	80.65	.24	74.39	68.21	.22
32	101.67	91.05	.25	78.13	.23	72.06	66.08	.21
33	98.59	88.29	.24	75.76	.22	69.88	64.07	.21
34	95.69	85.70	.23	73.53	.22	67.82	62.19	.20
35	92.96	83.25	.22	71.43	.21	65.88	60.41	.19
36	90.38	80.93	.22	69.45	.20	64.05	58.73	.19
37	87.93	78.75	.21	67.57	.20	62.32	57.15	.18
38	85.62	76.67	.21	65.79	.19	60.68	55.64	.18
39	83.42	74.71	.20	64.10	.19	59.13	54.22	.17
40	81.34	72.84	.20	62.50	.18	57.65	52.86	.17
41	79.35	71.06	.19	60.98	.18	56.24	51.57	.17
42	77.47	69.37	.19	59.53	.17	54.90	50.34	.16
43	75.66	67.76	.18	58.14	.17	53.63	49.17	.16
44	73.94	66.22	.18	56.82	.17	52.41	48.06	.15
45	72.30	64.75	.17	55.56	.16	51.24	46.99	.15
46	70.73	63.34	.17	54.35	.16	50.13	45.97	.15
47	69.22	61.99	.17	53.19	.16	49.06	44.99	.14
48	67.78	60.70	.16	52.09	.15	48.04	44.05	.14

Safe loads given include weight of beam.

Maximum fiber stress, 16,000 pounds per square inch.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	24" G		Add for Each Pound Increase in Weight	20" G		Add for Each Pound Increase in Weight	18" G	Add for Each Pound Increase in Weight
	G-24-a	G-24		G-20-a	G-20		G-18	
	140 Pounds	120 Pounds		140 Pounds	112 Pounds		92 Pounds	
12	155.61	133.60	.52	130.43	104.09	.44	78.59	.39
13	143.64	123.33	.48	120.40	96.09	.40	72.54	.36
14	133.38	114.52	.45	111.80	89.23	.37	67.36	.34
15	124.48	106.88	.42	104.34	83.28	.35	62.87	.31
16	116.71	100.20	.39	97.82	78.07	.33	58.94	.29
17	109.84	94.31	.37	92.07	73.48	.31	55.47	.28
18	103.74	89.07	.35	86.95	69.40	.29	52.39	.26
19	98.28	84.38	.33	82.38	65.74	.28	49.63	.25
20	93.37	80.16	.31	78.26	62.46	.26	47.15	.24
21	88.92	76.35	.30	74.53	59.48	.25	44.91	.22
22	84.88	72.88	.29	71.14	56.78	.24	42.87	.21
23	81.19	69.71	.27	68.05	54.31	.23	41.00	.20
24	77.80	66.80	.26	65.22	52.05	.22	39.29	.20
25	74.69	64.15	.25	62.61	49.97	.21	37.72	.19
26	71.82	61.66	.24	60.20	48.04	.20	36.27	.18
27	69.16	59.38	.23	57.97	46.26	.19	34.93	.17
28	66.69	57.26	.22	55.90	44.61	.19	33.68	.17
29	64.39	55.29	.22	53.97	43.07	.18	32.52	.16
30	62.24	53.44	.21	52.17	41.64	.17	31.43	.16
31	60.24	51.72	.20	50.49	40.30	.17	30.42	.15
32	58.35	50.10	.20	48.91	39.04	.16	29.47	.15
33	56.58	48.58	.19	47.43	37.85	.16	28.58	.14
34	54.92	47.15	.18	46.04	36.74	.15	27.74	.14
35	53.35	45.81	.18	44.72	35.69	.15	26.94	.13
36	51.87	44.54	.17	43.48	34.70	.15	26.20	.13
37	50.47	43.33	.17	42.30	33.76	.14	25.49	.13
38	49.14	42.19	.17	41.19	32.87	.14	24.82	.12
39	47.88	41.11	.16	40.13	32.03	.13	24.18	.12
40	46.68	40.08	.16	39.13	31.23	.13	23.58	.12

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted line produce deflections exceeding $\frac{1}{800}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	15" G			Add for Each Pound Increase in Weight	12" G		Add for Each Pound Increase in Weight
	G-15-b	G-15-a	G-15		G-12-a	G-12	
	140 Pounds	101 Pounds	73 Pounds		70 Pounds	55 Pounds	
10	113.26	86.76	62.83	.39	47.89	38.40	.31
11	102.96	78.88	57.12	.36	43.54	34.91	.29
12	94.38	72.30	52.36	.33	39.91	32.00	.26
13	87.12	66.74	48.33	.30	36.84	29.54	.24
14	80.90	61.97	44.88	.28	34.21	27.43	.22
15	75.51	57.84	41.89	.26	31.93	25.60	.21
16	70.79	54.23	39.27	.25	29.93	24.00	.20
17	66.62	51.04	36.96	.23	28.17	22.59	.19
18	62.92	48.20	34.91	.22	26.61	21.33	.18
19	59.61	45.67	33.07	.21	25.21	20.21	.17
20	56.63	43.38	31.42	.20	23.95	19.20	.16
21	53.93	41.32	29.92	.19	22.81	18.28	.15
22	51.48	39.44	28.56	.18	21.77	17.45	.14
23	49.24	37.72	27.32	.17	20.82	16.69	.14
24	47.19	36.15	26.18	.16	19.95	16.00	.13
25	45.30	34.71	25.13	.16	19.16	15.36	.13
26	43.56	33.37	24.17	.15	18.42	14.77	.12
27	41.95	32.13	23.27	.15	17.74	14.22	.12
28	40.45	30.99	22.44	.14	17.10	13.71	.11
29	39.05	29.92	21.67	.14	16.51	13.24	.11
30	37.75	28.92	20.94	.13	15.96	12.80	.10
31	36.54	27.99	20.27	.13	15.45	12.39	.10
32	35.39	27.11	19.63	.12	14.97	12.00	.10
33	34.32	26.29	19.04	.12	14.51	11.64	.10
34	33.31	25.52	18.48	.12	14.09	11.29	.09
35	32.36	24.79	17.95	.11	13.68	10.97	.09

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Load given above the heavy line is greater than a safe load for web crippling.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{800}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Feet	10" G	Add for Each Pound Increase in Weight	Span, in Feet	9" G	Add for Each Pound Increase in Weight	8" G	Add for Each Pound Increase in Weight
	G-10			G-9		G-8	
	44 Pounds			38 Pounds		32.5 Pounds	
10	26.05	.26	5	40.50	.47	30.51	.42
11	23.68	.24	6	33.75	.39	25.42	.35
12	21.71	.22	7	28.93	.34	21.79	.30
13	20.04	.20	8	25.31	.29	19.07	.26
14	18.61	.19	9	22.50	.26	16.95	.23
15	17.37	.17	10	20.25	.23	15.25	.21
16	16.28	.16	11	18.41	.21	13.87	.19
17	15.32	.15	12	16.88	.20	12.71	.17
18	14.47	.15	13	15.58	.18	11.73	.16
19	13.71	.14	14	14.47	.17	10.90	.15
20	13.03	.13	15	13.50	.16	10.17	.14
21	12.40	.12	16	12.66	.15	9.53	.13
22	11.84	.12	17	11.91	.14	8.97	.12
23	11.33	.11	18	11.25	.13	8.47	.12
24	10.85	.11	19	10.66	.12	8.03	.11
25	10.42	.10	20	10.13	.12	7.63	.10
26	10.02	.10	21	9.64	.11	7.26	.10
27	9.65	.10	22	9.21	.11	6.93	.09
28	9.30	.09	23	8.80	.10	6.63	.09
29	8.98	.09	24	8.44	.10	6.36	.08
30	8.68	.09	25	8.10	.09	6.10	.08
31	8.40	.08	26	7.79	.09		
32	8.14	.08	27	7.50	.09		
33	7.89	.08	28	7.23	.08		
34	7.66	.08	29	6.98	.08		
35	7.44	.07	30	6.75	.07		

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	30" I	Add for Each Pound Increase in Weight	28" I	Add for Each Pound Increase in Weight	26" I	Add for Each Pound Increase in Weight
	B-30		B-28		B-26	
	120 Pounds		105 Pounds		90 Pounds	
18	103.50	.44	84.95	.41	67.86	.38
19	98.05	.41	80.48	.39	64.29	.36
20	93.15	.39	76.46	.37	61.07	.34
21	88.71	.37	72.82	.35	58.16	.32
22	84.68	.36	69.51	.33	55.52	.31
23	81.00	.34	66.49	.32	53.11	.30
24	77.62	.33	63.72	.31	50.89	.28
25	74.52	.31	61.17	.29	48.86	.27
26	71.65	.30	58.81	.28	46.98	.26
27	69.00	.29	56.64	.27	45.24	.25
28	66.54	.28	54.61	.26	43.62	.24
29	64.24	.27	52.73	.25	42.12	.23
30	62.10	.26	50.97	.24	40.71	.23
31	60.10	.25	49.33	.24	39.40	.22
32	58.22	.25	47.79	.23	38.17	.21
33	56.45	.24	46.34	.22	37.01	.21
34	54.79	.23	44.98	.22	35.92	.20
35	53.23	.22	43.69	.21	34.90	.19
36	51.75	.22	42.48	.20	33.93	.19
37	50.35	.21	41.33	.20	33.01	.18
38	49.03	.21	40.24	.19	32.14	.18
39	47.77	.20	39.21	.19	31.32	.17
40	46.57	.20	38.23	.19	30.54	.17
41	45.44	.19	37.30	.18	29.79	.17
42	44.36	.19	36.41	.18	29.08	.16
43	43.33	.18	35.56	.17	28.41	.16
44	42.34	.18	34.75	.17	27.76	.15
45	41.40	.17	33.98	.16	27.14	.15
46	40.50	.17	33.24	.16	26.55	.15
47	39.64	.17	32.54	.16	25.99	.14
48	38.81	.16	31.86	.15	25.45	.14

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	24" I		Add for Each Pound Increase in Weight	20" I					Add for Each Pound Increase in Weight
	B-24-a	B-24		B-20-a		B-20			
				82 Pounds	72 Pounds	69 Pounds	64 Pounds	59 Pounds	
12	88.22	77.45	.52	69.33	65.18	56.40	54.32	52.10	.44
13	81.43	71.49	.48	63.99	60.17	52.06	50.14	48.09	.40
14	75.62	66.38	.45	59.42	55.87	48.34	46.56	44.65	.37
15	70.58	61.96	.42	55.46	52.14	45.12	43.45	41.68	.35
16	66.16	58.08	.39	51.99	48.88	42.30	40.74	39.07	.33
17	62.27	54.67	.37	48.94	46.01	39.81	38.34	36.77	.31
18	58.81	51.63	.35	46.22	43.45	37.60	36.21	34.73	.29
19	55.72	48.91	.33	43.78	41.17	35.62	34.31	32.90	.28
20	52.93	46.47	.31	41.60	39.11	33.84	32.59	31.26	.26
21	50.41	44.26	.30	39.61	37.25	32.23	31.04	29.77	.25
22	48.12	42.24	.29	37.81	35.55	30.76	29.63	28.42	.24
23	46.03	40.41	.27	36.17	34.01	29.42	28.34	27.18	.23
24	44.11	38.72	.26	34.66	32.59	28.20	27.16	26.05	.22
25	42.35	37.17	.25	33.28	31.29	27.07	26.07	25.01	.21
26	40.72	35.74	.24	32.00	30.08	26.03	25.07	24.04	.20
27	39.21	34.42	.23	30.81	28.97	25.07	24.14	23.15	.19
28	37.81	33.19	.22	29.71	27.93	24.17	23.28	22.33	.19
29	36.50	32.05	.22	28.69	26.97	23.34	22.48	21.56	.18
30	35.29	30.93	.21	27.73	26.07	22.56	21.73	20.84	.17
31	34.15	29.98	.20	26.84	25.23	21.83	21.03	20.17	.17
32	33.08	29.04	.20	26.00	24.44	21.15	20.37	19.54	.16
33	32.08	28.16	.19	25.21	23.70	20.51	19.75	18.94	.16
34	31.14	27.33	.19	24.47	23.00	19.90	19.17	18.39	.15
35	30.25	26.55	.18	23.77	22.35	19.34	18.62	17.86	.15
36	29.41	25.82	.17	23.11	21.73	18.80	18.11	17.37	.15
37	28.61	25.12	.17	22.48	21.14	18.29	17.62	16.90	.14
38	27.86	24.46	.17	21.89	20.58	17.81	17.15	16.45	.14
39	27.14	23.83	.16	21.33	20.06	17.35	16.71	16.03	.13
40	26.47	23.23	.16	20.80	19.55	16.92	16.30	15.63	.13

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	18" I			Add to Each Pound Increase in Weight	15" I					Add for Each Pound Increase in Weight
	B-18				B-15-b	B-15-a	B-15			
	59 Pounds	54 Pounds	48.5 Pounds				71 Pounds	54 Pounds	46 Pounds		41 Pounds	38 Pounds
12	43.62	41.58	39.42	.39	47.18	36.15	28.73	27.06	26.23	.33
13	40.26	38.38	36.39	.36	43.55	33.37	26.52	24.98	24.21	.30
14	37.39	35.64	33.79	.34	40.44	30.99	24.62	23.19	22.48	.28
15	34.90	33.26	31.54	.31	37.75	28.92	22.98	21.65	20.98	.25
16	32.71	31.18	29.56	.29	35.39	27.11	21.55	20.30	19.67	.26
17	30.79	29.35	27.83	.28	33.30	25.52	20.28	19.10	18.51	.23
18	29.08	27.72	26.28	.26	31.45	24.10	19.15	18.04	17.49	.22
19	27.55	26.26	24.90	.25	29.80	22.83	18.14	17.09	16.56	.21
20	26.17	24.95	23.65	.24	28.31	21.69	17.24	16.24	15.74	.20
21	24.93	23.76	22.53	.22	26.96	20.66	16.42	15.46	14.99	.19
22	23.79	22.68	21.50	.21	25.74	19.72	15.67	14.76	14.31	.18
23	22.76	21.70	20.57	.21	24.62	18.86	14.99	14.12	13.68	.17
24	21.81	20.79	19.71	.20	23.59	18.07	14.36	13.53	13.11	.16
25	20.94	19.96	18.92	.19	22.65	17.35	13.79	12.99	12.59	.16
26	20.13	19.19	18.19	.18	21.78	16.68	13.26	12.49	12.11	.15
27	19.39	18.48	17.52	.17	20.97	16.07	12.77	12.03	11.66	.15
28	18.69	17.82	16.89	.17	20.22	15.49	12.31	11.60	11.24	.14
29	18.05	17.21	16.31	.16	19.52	14.96	11.89	11.20	10.85	.14
30	17.45	16.63	15.77	.16	18.87	14.46	11.49	10.82	10.49	.13
31	16.88	16.10	15.26	.15	18.26	13.99	11.12	10.47	10.15	.13
32	16.36	15.59	14.78	.15	17.69	13.56	10.77	10.15	9.84	.12
33	15.86	15.12	14.33	.14	17.16	13.15	10.45	9.84	9.54	.12
34	15.40	14.68	13.91	.14	16.65	12.76	10.14	9.55	9.26	.12
35	14.96	14.26	13.52	.13	16.18	12.39	9.85	9.28	8.99	.11
36	14.54	13.86	13.14	.13	15.73	12.05	9.58	9.02	8.74	.11
37	14.15	13.49	12.78	.13	15.30	11.72	9.32	8.78	8.51	.11
38	13.77	13.13	12.45	.12	14.90	11.42	9.07	8.55	8.28	.10
39	13.42	12.79	12.13	.12	14.52	11.12	8.84	8.33	8.07	.10
40	13.09	12.47	11.83	.12	14.15	10.84	8.62	8.12	7.87	.10

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Load given above the heavy line exceeds safe load for web crippling.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN TONS OF 2000 POUNDS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span, in Feet	12" I			Add for Each Pound In- crease in Weight	10" I		Add for Each Pound In- crease in Weight
	B-12-a	B-12			B-10		
		36 Pounds	32 Pounds		28.5 Pounds	28.5 Pounds		23.5 Pounds
9	26.59	22.57	21.36	.35	15.95	14.57	.29
10	23.93	20.31	19.22	.31	14.35	13.11	.26
11	21.76	18.46	17.47	.29	13.05	11.92	.24
12	19.94	16.92	16.02	.26	11.96	10.92	.22
13	18.41	15.62	14.79	.24	11.04	10.08	.20
14	17.09	14.51	13.73	.22	10.25	9.36	.19
15	15.95	13.54	12.81	.21	9.57	8.74	.17
16	14.96	12.69	12.01	.20	8.97	8.19	.16
17	14.08	11.95	11.31	.19	8.44	7.71	.15
18	13.30	11.28	10.68	.17	7.97	7.28	.15
19	12.60	10.69	10.12	.17	7.55	6.90	.14
20	11.97	10.15	9.61	.16	7.18	6.55	.13
21	11.40	9.67	9.15	.15	6.84	6.24	.12
22	10.88	9.23	8.74	.14	6.52	5.96	.12
23	10.41	8.83	8.36	.14	6.24	5.70	.11
24	9.97	8.46	8.01	.13	5.98	5.46	.11
25	9.57	8.12	7.69	.13	5.74	5.24	.10
26	9.20	7.81	7.39	.12	5.52	5.04	.10
27	8.86	7.52	7.12	.12	5.32	4.86	.10
28	8.55	7.25	6.86	.11	5.13	4.68	.09
29	8.25	7.00	6.63	.11	4.95	4.52	.09
30	7.98	6.77	6.41	.11	4.78	4.37	.09
31	7.72	6.55	6.20	.10			
32	7.48	6.35	6.01	.10			
33	7.25	6.15	5.82	.10			
34	7.04	5.97	5.65	.09			
35	6.84	5.80	5.49	.09			

Safe loads given include weight of beam. Maximum fiber stress, 16,000 pounds per square inch.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{250}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM ROLLED GIRDER BEAMS

IN METRIC TONS OF 1000 KILOGRAMS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	30" G		28" G	26" G		24" G		Span in Meters
	G-30-a	G-30	G-28	G-26-a	G-26	G-24-a	G-24	
	297.6 Kg.	267.9 Kg.	245.6 Kg.	238.1 Kg.	223.2 Kg.	208.3 Kg.	178.6 Kg.	
5.0	.....	.....	.....	.....	124.74	110.16	.....	5.0
5.5	174.49	.....	134.08	123.67	113.40	100.14	85.98	5.5
6.0	159.95	143.24	122.91	113.36	103.95	91.80	78.82	6.0
6.5	147.64	132.22	113.45	104.64	95.95	84.74	72.76	6.5
7.0	137.10	122.77	105.35	97.17	89.10	78.68	67.56	7.0
7.5	127.96	114.59	98.32	90.69	83.16	73.44	63.05	7.5
8.0	119.96	107.43	92.18	85.02	77.96	68.85	59.11	8.0
8.5	112.90	101.11	86.76	80.02	73.37	64.80	55.64	8.5
9.0	106.63	95.49	81.94	75.58	69.30	61.20	52.55	9.0
9.5	101.02	90.47	77.62	71.60	65.65	57.98	49.78	9.5
10.0	95.97	85.94	73.74	68.02	62.37	55.08	47.29	10.0
10.5	91.40	81.85	70.23	64.78	59.40	52.46	45.04	10.5
11.0	87.24	78.13	67.04	61.83	56.70	50.07	42.99	11.0
11.5	83.45	74.73	64.12	59.15	54.23	47.89	41.12	11.5
12.0	79.97	71.62	61.45	56.68	51.97	45.90	39.41	12.0
12.5	76.78	68.75	58.99	54.41	49.89	44.06	37.83	12.5
13.0	73.82	66.11	56.73	52.32	47.98	42.37	36.38	13.0
13.5	71.09	63.66	54.62	50.38	46.20	40.80	35.03	13.5
14.0	68.55	61.39	52.67	48.58	44.55	39.34	33.78	14.0
14.5	66.19	59.27	50.86	46.91	43.01	37.99	32.61	14.5
15.0	63.98	57.29	49.16	45.35	41.58	.....	.....	15.0
15.5	61.92	55.45	47.58	.....	.....	.....	.....	15.5
16.0	59.98	53.71	.....	.....	.....	.....	.....	16.0

Safe loads given below the dotted lines produce deflections exceeding 1/10 of the span.

Safe loads given include weight of beam.

Maximum fibre stress, 1,200 kilograms per square centimeter.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM ROLLED GIRDER BEAMS

IN METRIC TONS OF 1000 KILOGRAMS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	20" G		18" G	15" G			Span in Meters
	G-20-a	G-20	G-18	G-15-b	G-15-a	G-15	
	208.3 Kg.	166.7 Kg.	136.9 Kg.	208.3 Kg.	154.8 Kg.	108.6 Kg.	
3.0	.....	.....	.....	111.36	85.31	.....	3.0
3.5	.....	.....	.....	95.45	73.12	52.95	3.5
4.0	115.42	92.12	69.54	83.52	63.98	46.33	4.0
4.5	102.59	81.88	61.82	74.24	56.87	41.18	4.5
5.0	92.33	73.69	55.63	66.82	51.19	37.07	5.0
5.5	83.94	66.99	50.58	60.74	46.53	33.70	5.5
6.0	76.95	61.41	46.36	55.68	42.66	30.89	6.0
6.5	71.03	56.69	42.80	51.40	39.37	28.51	6.5
7.0	65.95	52.64	39.74	47.73	36.56	26.48	7.0
7.5	61.56	49.13	37.09	44.54	34.12	24.71	7.5
8.0	57.71	46.06	34.77	41.76	31.99	23.17	8.0
8.5	54.31	43.35	32.73	39.30	30.11	21.80	8.5
9.0	51.30	40.94	30.91	37.12	28.44	20.59	9.0
9.5	48.60	38.79	29.28	35.17	26.94	19.51	9.5
10.0	46.17	36.85	27.82	33.41	25.59	18.53	10.0
10.5	43.97	35.09	26.49	31.82	24.37	17.65	10.5
11.0	41.97	33.50	25.29	30.37	23.27	16.85	11.0
11.5	40.15	32.04	24.19	29.05	22.25	16.12	11.5
12.0	38.47	30.71	23.18	.....	.....	.....	12.0
12.5	36.93	29.48	22.25	.....	.....	.....	12.5

Safe loads given include weight of beam. Maximum fiber stress, 1,200 kilograms per square centimeter.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{300}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM ROLLED GIRDER BEAMS

IN METRIC TONS OF 1000 KILOGRAMS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	12" G		10" G	9" G	8" G	Span in Meters
	G-12-a	G-12	G-10	G-9	G-8	
	104.2 Kg.	81.9 Kg.	65.5 Kg.	56.6 Kg.	48.4 Kg.	
2.5	.....	.....	.....	23.89	18.00	2.5
3.0	47.09	37.76	25.61	19.91	15.00	3.0
3.5	40.36	32.36	21.95	17.07	12.86	3.5
4.0	35.32	28.32	19.21	14.93	11.25	4.0
4.5	31.39	25.17	17.08	13.27	10.00	4.5
5.0	28.25	22.65	15.37	11.95	9.00	5.0
5.5	25.68	20.59	13.97	10.86	8.18	5.5
6.0	23.54	18.88	12.81	9.96	7.50	6.0
6.5	21.73	17.43	11.82	9.19	6.92	6.5
7.0	20.18	16.18	10.98	8.53	6.43	7.0
7.5	18.83	15.10	10.25	7.96	6.00	7.5
8.0	17.66	14.16	9.61	7.47	5.63	8.0
8.5	16.62	13.33	9.04	7.03	.....	8.5
9.0	15.70	12.59	8.54	6.64	.....	9.0
9.5	14.87	11.92	8.09	.....	.....	9.5
10.0	14.13	11.33	.....	.....	.....	10.0
10.5	13.45	10.79	.....	.....	.....	10.5

Safe loads given include weight of beam. Maximum fibre stress, 1,200 kilograms per square centimeter.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{160}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN METRIC TONS OF 1000 KILOGRAMS
BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	30'' I	28'' I	26'' I	24'' I			20'' I		Span in Meters
	B-30	B-28	B-26	B-24-a	B-24		B-20-a		
	178.6 Kg.	156.3 Kg.	133.9 Kg.	125.0 Kg.	123.5 Kg.	108.6 Kg.	122.0 Kg.	107.2 Kg.	
3.0	.....	.....	.....	.....	.....	.....	81.79	.....	3.0
3.5	.....	.....	.....	.....	83.93	.....	70.11	.....	3.5
4.0	.....	.....	.....	.....	73.44	.....	61.35	57.68	4.0
4.5	.....	.....	.....	.....	65.28	.....	54.53	51.27	4.5
5.0	.....	.....	.....	62.45	58.75	.....	49.08	46.14	5.0
5.5	.....	82.01	65.50	56.78	53.41	49.84	44.61	41.95	5.5
6.0	91.59	75.18	60.05	52.05	48.96	45.69	40.90	38.45	6.0
6.5	84.54	69.40	55.43	48.04	45.20	42.17	37.75	35.49	6.5
7.0	78.50	64.44	51.47	44.61	41.97	39.16	35.05	32.96	7.0
7.5	73.27	60.14	48.04	41.64	39.17	36.55	32.72	30.76	7.5
8.0	68.69	56.38	45.03	39.03	36.72	34.27	30.67	28.84	8.0
8.5	64.65	53.07	42.38	36.74	34.56	32.25	28.87	27.14	8.5
9.0	61.06	50.12	40.03	34.70	32.64	30.46	27.26	25.63	9.0
9.5	57.85	47.48	37.92	32.87	30.92	28.86	25.83	24.29	9.5
10.0	54.95	45.11	36.03	31.23	29.38	27.41	24.54	23.07	10.0
10.5	52.34	42.96	34.31	29.74	27.98	26.11	23.37	21.97	10.5
11.0	49.96	41.01	32.75	28.39	26.71	24.92	22.31	20.97	11.0
11.5	47.79	39.22	31.33	27.15	25.55	23.84	21.34	20.06	11.5
12.0	45.79	37.59	30.02	26.02	24.48	22.84	20.45	19.23	12.0
12.5	43.96	36.09	28.82	24.98	23.50	21.93	19.63	18.46	12.5
13.0	42.27	34.70	27.71	24.02	22.60	21.09	.....	.....	13.0
13.5	40.71	33.41	26.69	23.13	21.76	20.31	.....	.....	13.5
14.0	39.25	32.22	25.73	22.31	20.98	19.58	.....	.....	14.0
14.5	37.90	31.11	24.85	.....	.....	.....	.....	.....	14.5
15.0	36.64	30.07	24.02	.....	.....	.....	.....	.....	15.0

Safe loads given include weight of beam. Maximum fibre stress, 1200 kilograms per square centimeter.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{160}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN METRIC TONS OF 1000 KILOGRAMS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	20" I			18" I				15" I	Span in Meters
	B-20			B-18				B-15-b	
	102.7 Kg.	95.2 Kg.	87.8 Kg.	87.8 Kg.	80.4 Kg.	77.4 Kg.	72.2 Kg.	105.7 Kg.	
2.5	79.85	.....	.....	61.76	.....	.....	.....	66.80	2.5
3.0	66.54	64.09	.....	51.47	49.06	.....	.....	55.67	3.0
3.5	57.03	54.93	.....	44.11	42.05	41.20	.....	47.72	3.5
4.0	49.91	48.07	46.10	38.60	36.79	36.05	.....	41.75	4.0
4.5	44.36	42.72	40.98	34.31	32.70	32.04	31.01	37.11	4.5
5.0	39.92	38.45	36.88	30.88	29.43	28.84	27.91	33.40	5.0
5.5	36.29	34.96	33.53	28.07	26.76	26.22	25.37	30.37	5.5
6.0	33.27	32.04	30.73	25.73	24.53	24.03	23.26	27.84	6.0
6.5	30.71	29.58	28.37	23.75	22.64	22.18	21.47	25.69	6.5
7.0	28.52	27.47	26.34	22.06	21.02	20.60	19.93	23.86	7.0
7.5	26.62	25.63	24.59	20.59	19.62	19.23	18.60	22.27	7.5
8.0	24.95	24.03	23.05	19.30	18.40	18.03	17.44	20.88	8.0
8.5	23.48	22.62	21.69	18.16	17.31	16.96	16.42	19.65	8.5
9.0	22.18	21.36	20.49	17.16	16.35	16.02	15.50	18.56	9.0
9.5	21.01	20.24	19.41	16.25	15.49	15.18	14.69	17.58	9.5
10.0	19.96	19.23	18.44	15.44	14.72	14.42	13.95	16.70	10.0
10.5	19.01	18.31	17.56	14.70	14.02	13.73	13.29	15.91	10.5
11.0	18.15	17.48	16.76	14.04	13.38	13.11	12.68	15.18	11.0
11.5	17.36	16.72	16.03	13.43	12.80	12.54	12.13	.....	11.5
12.0	16.64	16.02	15.37	12.87	12.26	12.02	11.63	.....	12.0

Safe loads given include weight of beam. Maximum fibre stress, 1,200 kilograms per square centimeter.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{320}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR BETHLEHEM I-BEAMS

IN METRIC TONS OF 1000 KILOGRAMS

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS

Span in Meters	15" I					12" I			10" I		Span in Meters
	B-15-a		B-15			B-12a	B-12		B-10		
	95.2 Kg.	80.4 Kg.	68.5 Kg.	61.0 Kg.	56.6 Kg.		53.6 Kg.	47.6 Kg.	42.4 Kg.	42.4 Kg.		35.0 Kg.
2.0	69.73	.....	50.85	.....	.....	.....	29.96	.....	21.17	19.34	2.0
2.5	55.78	51.18	40.68	.....	.....	28.24	23.96	.....	16.94	15.47	2.5
3.0	46.49	42.65	33.90	31.93	.....	23.53	19.97	18.90	14.11	12.89	3.0
3.5	39.85	36.56	29.05	27.37	26.53	20.17	17.12	16.20	12.10	11.05	3.5
4.0	34.87	31.99	25.42	23.95	23.21	17.65	14.98	14.17	10.59	9.67	4.0
4.5	30.99	28.44	22.60	21.28	20.63	15.69	13.31	12.60	9.41	8.59	4.5
5.0	27.89	25.59	20.34	19.16	18.57	14.12	11.98	11.34	8.47	7.73	5.0
5.5	25.36	23.27	18.49	17.41	16.88	12.83	10.89	10.31	7.70	7.03	5.5
6.0	23.24	21.33	16.95	15.96	15.47	11.77	9.99	9.45	7.06	6.45	6.0
6.5	21.46	19.69	15.64	14.74	14.28	10.86	9.22	8.72	6.51	5.95	6.5
7.0	19.92	18.28	14.53	13.68	13.26	10.08	8.56	8.10	6.05	5.52	7.0
7.5	18.59	17.06	13.56	12.77	12.38	9.41	7.99	7.56	5.65	5.16	7.5
8.0	17.43	16.00	12.71	11.97	11.61	8.82	7.49	7.09	5.29	4.83	8.0
8.5	16.41	15.05	11.96	11.27	10.92	8.30	7.05	6.67	4.98	4.55	8.5
9.0	15.50	14.22	11.30	10.64	10.32	7.84	6.66	6.30	4.70	4.30	9.0
9.5	14.68	13.47	10.70	10.08	9.77	7.43	6.31	5.97	4.46	4.07	9.5
10.0	13.95	12.80	10.17	9.58	9.28	7.06	5.99	5.67	.....	.....	10.0
10.5	13.28	12.19	9.68	9.12	8.84	6.72	5.71	5.40	.....	.....	10.5
11.0	12.68	11.63	9.24	8.71	8.44	.....	.....	.....	.....	.....	11.0

Safe loads given include weight of beam. Maximum fibre stress, 1,200 kilograms per square centimeter.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{100}$ of the span.

EXPLANATION OF TABLES OF SAFE LOADS FOR BETHLEHEM ROLLED STEEL H-COLUMNS

The superiority of steel columns over columns of any other material is so well understood and recognized as to need no comment. Cast iron columns are sometimes used solely on the score of cheapness because of the relatively greater cost of riveted steel columns—the only kind of steel columns heretofore obtainable; but in buildings of anything more than the most moderate height, or wherever stiffness of frame and absolute security are essential, steel columns are employed exclusively.

Bethlehem Rolled Steel H-Sections reduce the cost of steel columns to such an extent that they can be used for all purposes with economy. These rolled steel columns provide all the desired qualities of safety and reliability at a cost less than that of any other form of steel column and at a cost as low or even less than cast iron.

For very short lengths the compressive strength of structural steel of standard quality is the same as its tensile strength. As the length increases the compressive strength diminishes. A short column has a practically uniform compressive strength for all lengths less than about fifteen times its least diameter; but for greater lengths the strength decreases, the decrease being a function of the length of the column and the radius of gyration of the section in the direction of its least resistance to bending. Conforming to these conditions, the safe allowable stress, in pounds per square inch, on square ended columns of medium steel used for buildings is given by the following formula:

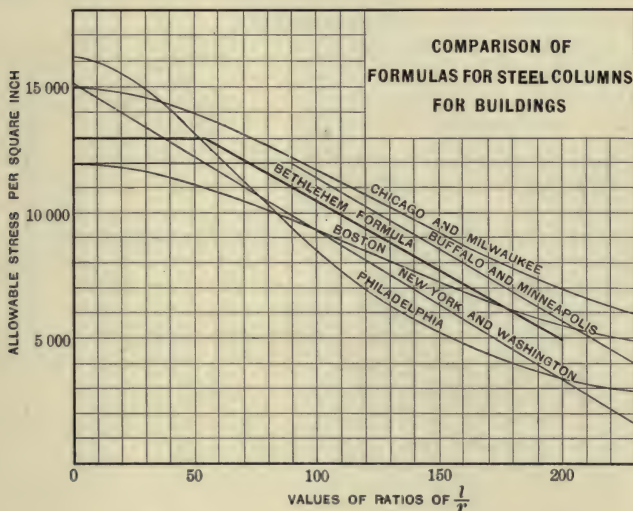
13,000 pounds for lengths under 55 radii of gyration,

$16,000 - 55 \frac{l}{r}$ for lengths over 55 radii of gyration,

in which l = unsupported length of column and r = least radius of gyration, both in inches.

The safe strength of steel columns given by this formula agrees in a satisfactory manner with the available experimental data on the subject. In addition it is of correct theoretical form. It represents a straight line which becomes tangent to the curve of Euler's Formula for very long columns and fixes a maximum limit of stress for columns of relatively short length. The safe stress allowed on steel columns by this rule corresponds to the safe stress usually allowed for beams and girders in buildings. Columns proportioned in accordance with this formula have the same proper degree of safety as the beams and girders which they support, thus maintaining a symmetrical proportion of all parts of the structure.

A comparison of this formula with the column formulas specified by the building laws of the principal cities in the United States is shown by the diagram herewith, from which it will be seen that it represents about an average of general practice.



A riveted column, having the metal in its shaft injured and weakened by the punching of numerous rivet holes, is liable to fail under a less load than a rolled column in which the shaft is devoid of rivets. The formula does not take into consideration this advantage in favor of the rolled steel column sections. It represents only the best current practice in general steel column design and is not limited to columns of special or superior shape.

Safe loads computed by this formula are given in the tables on pages 100-107 and 114-121 for all the sizes of Bethlehem Rolled H-Columns and on pages 96-99 and 110-113 for Bethlehem I-Beams and Girder Beams when used as columns. The column required for any given load and length is readily selected from these tables.

The unsupported length of a column should not exceed 150 radii of gyration, which is the limit of length for which safe loads are given in the tables. In the best practice the unsupported length of a column is frequently required not to exceed 125 times the least radius of gyration; this latter limit is indicated in the tables by zigzag lines.

An example is given on page 95 showing the method of selecting rolled H-column sections for buildings, to which reference should be made. Wherever possible it is desirable to provide for the given range of loads by selecting the different weights required from the variations in size offered by columns of the same section. Columns thus selected can be obtained from the same rolling, thereby avoiding delay in delivery.

Abutting sections of columns, in addition to having machine squared ends, should be connected by splices of sufficient size to maintain the continuity of section required for preserving the rigidity of the steel frame work of the building or structure. The method of splicing column sections and the manner of connecting beams and girders are shown by the illustrations on page 157. Weights given of the various column sections do not include splices or connections of any kind.

The safe loads given in the tables are for concentric or symmetrical loading. When the loads are not centrally or symmetrically applied, bending is produced in the column, the effect of which must be considered. The unbalanced bending moment of the eccentric loads about the center of the column, in inch-pounds, divided by the section modulus of the column in the direction of bending gives the stress in pounds per square inch produced by the bending. The load on the column produces a uniform compressive stress over the whole cross section to which the bending stress must be added. The sum is the maximum stress on the extreme fibers of the column section.

The maximum fiber stress due to direct load and bending must not be more than 25 per cent in excess of the permissible stress on the column, for the given length, obtained from the formula for concentric loading, otherwise the section of the column must be increased until this limit is not exceeded.

The section modulus about each principal axis for all the sections of rolled H-columns is given in the tables of their properties on pages 52-59 and 60-67, by means of which the effect of eccentric loading is easily calculated and considered in the above manner.

METHOD OF SELECTING BETHLEHEM ROLLED H-COLUMNS FOR BUILDINGS

EXAMPLE

For illustration, the interior columns of an actual 16-story building are taken as an example. The story heights and the loads on the columns are given in the following table:

Story	Height of Story, Feet	Load on Column, Tons	H-Column Section Required					Section Number
			Safe Load, Tons	Dimensions in Inches			Weight of Section, Pounds per Foot	
				D	T	B		
16th	12	27	55.0	7 ⁷ / ₈	7 ¹ / ₁₆	8.00	31.5	H-8
15th	13	53	81.5	8 ³ / ₈	1 ¹ / ₁₆	8.12	48.0	H-8
14th	14	79						
13th	13	104	132.2	10 ³ / ₈	1 ³ / ₁₆	10.12	71.0	H-10
12th	13	128						
11th	13	151	174.8	12 ¹ / ₄	7 ⁷ / ₈	12.08	91.5	H-12
10th	13	174						
9th	13	197	219.1	14 ¹ / ₄	1 ⁵ / ₁₆	14.08	114.5	H-14
8th	13	219						
7th	13	241	263.8	14 ⁵ / ₈	1 ¹ / ₈	14.19	138.0	H-14
6th	13	261						
5th	13	281	310.1	15	1 ⁵ / ₁₆	14.31	162.0	H-14
4th	13	301						
3d	13	321	341.3	15 ¹ / ₄	1 ⁷ / ₁₆	14.39	178.5	H-14
2d	15	341						
1st	17	363	403.5	15 ³ / ₄	1 ¹¹ / ₁₆	14.54	211.0	H-14
Basement	12	395						

Columns for buildings are usually selected in lengths of two stories. By inspection of the tables of safe loads for H-columns, it is found that no columns smaller than 14-inch H-sections have sufficient capacity for the lower stories. From the tables on pages 100-101 or 114-115 the 14-inch H-columns required are then selected for the lower stories; and from the tables on pages 102-107, or 116-121, the 12-inch, 10-inch and 8-inch columns are selected for the upper stories.

All the sizes of columns, as selected and given in the above table, from the basement to the 9th story inclusive, are obtainable from the same rolls at a single rolling.

Where there is no limitation as to the size of the column the largest dimension column having the required capacity will be the most economical.

SAFE LOADS FOR BETHLEHEM GIRDER BEAMS USED AS COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.

Section Num- ber	Depth of Beam, Inches	Weight per Foot, Pounds	Area of Section, Square Inches	Least Radius of Gy- ration, Inches	Unsupported Length of Columns in Feet					
					8 Feet	9 Feet	10 Feet	11 Feet	12 Feet	13 Feet
G-30-a	30	200.0	58.71	3.28	381.6	381.6	381.6	381.6	381.6	381.6
G-30	30	180.0	53.00	2.86	344.5	344.5	344.5	344.5	344.5	344.5
G-28	28	165.0	48.47	2.77	315.1	315.1	315.1	315.1	315.1	312.7
G-26-a	26	160.0	46.91	3.05	304.9	304.9	304.9	304.9	304.9	304.9
G-26	26	150.0	43.94	2.68	285.6	285.6	285.6	285.6	285.6	281.2
G-24-a	24	140.0	41.16	2.90	267.5	267.5	267.5	267.5	267.5	267.5
G-24	24	120.0	35.38	2.66	230.0	230.0	230.0	230.0	230.0	225.8
G-20-a	20	140.0	41.19	2.91	267.8	267.8	267.8	267.8	267.8	267.8
G-20	20	112.0	32.81	2.70	213.3	213.3	213.3	213.3	213.3	210.4
G-18	18	92.0	27.12	2.59	176.3	176.3	176.3	176.3	175.5	172.0
G-15-b	15	140.0	41.27	2.83	268.2	268.2	268.2	268.2	268.2	267.6
G-15-a	15	104.0	30.50	2.64	198.3	198.3	198.3	198.3	198.3	194.4
G-15	15	73.0	21.49	2.39	139.7	139.7	139.7	139.3	136.3	133.4
G-12-a	12	70.0	20.58	2.36	133.8	133.8	133.8	133.0	130.1	127.3
G-12	12	55.0	16.18	2.24	105.2	105.2	105.2	103.2	100.9	98.5
G-10	10	44.0	12.95	2.10	84.1	84.1	83.2	81.2	79.2	77.1
G-9	9	38.0	11.22	1.98	72.9	72.9	71.1	69.2	67.3	65.4
G-8	8	32.5	9.54	1.86	62.0	61.1	59.4	57.7	56.0	54.3

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS FOR BETHLEHEM GIRDER BEAMS USED AS COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55\frac{1}{r}$ for lengths over 55 radii.

Unsupported Length of Columns in Feet										Section Number
14 Feet	15 Feet	16 Feet	18 Feet	20 Feet	22 Feet	24 Feet	28 Feet	32 Feet	36 Feet	
381.6	381.6	375.2	363.4	351.5	339.7	327.9	304.3	280.7	257.0	G-30-a
338.4	332.3	326.2	313.9	301.7	289.5	277.2	252.8	228.3	203.9	G-30
306.9	301.1	295.4	283.8	272.3	260.7	249.2	226.1	203.0	179.9	G-28
304.2	299.2	294.1	283.9	273.8	263.6	253.5	233.2	212.9	192.6	G-26-a
275.8	270.4	265.0	254.1	243.3	232.5	221.7	200.0	178.4	156.8	G-26
263.7	259.0	254.3	245.0	235.6	226.2	216.9	198.1	179.4	160.7	G-24-a
221.4	217.0	212.6	203.8	194.9	186.1	177.3	159.7	142.1	124.4	G-24
264.1	259.5	254.8	245.5	236.1	226.8	217.4	198.8	180.1	161.4	G-20-a
206.4	202.3	198.3	190.3	182.3	174.3	166.2	150.2	134.2	.....	G-20
168.6	165.1	161.7	154.8	147.9	140.9	134.0	120.2	106.4	.....	G-18
262.8	258.0	253.2	243.5	233.9	224.3	214.7	195.4	176.2	.....	G-15-b
190.6	186.8	183.0	175.4	167.8	160.1	152.5	137.3	122.0	.....	G-15-a
130.4	127.4	124.5	118.5	112.6	106.7	100.7	88.9	.....	.....	G-15
124.4	121.5	118.6	112.9	107.1	101.4	95.6	84.1	.....	.....	G-12-a
96.1	93.7	91.3	86.6	81.8	77.0	72.3	62.7	.....	.....	G-12
75.1	73.1	71.0	67.0	62.9	58.8	54.7	.....	.....	.....	G-10
63.6	61.7	59.8	56.1	52.4	48.6	44.9	.....	.....	.....	G-9
52.7	51.0	49.3	45.9	42.5	39.1	35.7	.....	.....	.....	G-8

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS FOR BETHLEHEM I-BEAMS

USED AS COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS

Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns					
					5 Feet	6 Feet	7 Feet	8 Feet	9 Feet	10 Feet
B-30	30	120.0	35.30	2.16	229.5	229.5	229.5	229.5	229.5	228.5
B-28	28	105.0	30.88	2.06	200.7	200.7	200.7	200.7	200.7	197.6
B-26	26	90.0	26.49	1.95	172.2	172.2	172.2	172.2	171.6	167.1
B-24-a	24	84.0	24.80	1.92	161.2	161.2	161.2	161.2	160.0	155.8
B-24	24	83.0	24.59	1.78	159.9	159.9	159.9	159.9	155.7	151.2
	24	73.0	21.47	1.86	139.6	139.6	139.6	139.6	137.5	133.7
B-20-a	20	82.0	24.17	1.82	157.1	157.1	157.1	157.1	153.9	149.5
	20	72.0	21.37	1.88	138.9	138.9	138.9	138.9	137.2	133.5
B-20	20	69.0	20.26	1.59	131.7	131.7	131.7	128.4	124.2	120.0
	20	64.0	18.86	1.62	122.6	122.6	122.6	120.1	116.3	112.5
	20	59.0	17.36	1.66	112.8	112.8	112.8	111.3	107.8	104.4
B-18	18	59.0	17.40	1.50	113.1	112.4	112.4	108.6	104.8	100.9
	18	54.0	15.87	1.54	103.2	103.2	103.2	99.8	96.4	93.0
	18	52.0	15.24	1.56	99.1	99.1	99.1	96.2	92.9	89.7
	18	48.5	14.25	1.59	92.7	92.7	92.7	90.4	87.4	84.5
B-15-b	15	71.0	20.95	1.71	136.2	136.2	136.2	135.3	131.2	127.2
B-15-a	15	64.0	18.81	1.49	122.3	122.3	121.3	117.1	113.0	108.8
	15	54.0	15.88	1.55	103.2	103.2	103.2	100.0	96.6	93.3
B-15	15	46.0	13.52	1.36	87.9	87.9	85.2	81.9	78.6	75.3
	15	41.0	12.02	1.41	78.1	78.1	76.5	73.6	70.8	68.0
	15	38.0	11.27	1.44	73.2	73.2	72.1	69.5	66.9	64.3
B-12-a	12	36.0	10.61	1.42	69.0	69.0	67.6	65.2	62.7	60.2
B-12	12	32.0	9.44	1.30	61.4	61.2	58.8	56.4	54.0	51.6
	12	28.5	8.42	1.35	54.8	54.8	53.0	50.9	48.9	46.8
B-10	10	28.5	8.34	1.21	54.2	53.0	50.8	48.5	46.2	44.0
	10	23.5	6.94	1.27	45.1	44.7	42.9	41.1	39.3	37.5

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS FOR BETHLEHEM I-BEAMS USED AS COLUMNS IN TONS OF 2000 POUNDS SQUARE ENDS

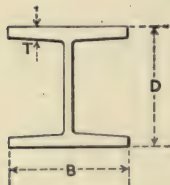
Unsupported Length of Columns										Section Number
11 Feet	12 Feet	13 Feet	14 Feet	15 Feet	16 Feet	18 Feet	20 Feet	22 Feet	24 Feet	
223.1	217.7	212.3	206.9	201.5	196.1	185.3	174.6	163.8	153.0	B-30
192.6	187.7	182.7	177.8	172.9	167.9	158.0	148.1	138.2	128.3	B-28
162.6	158.1	153.6	149.1	144.7	140.2	131.2	122.3	113.3	104.3	B-26
151.5	147.2	143.0	138.7	134.4	130.2	121.7	113.1	104.6	96.1	B-24-a
146.6	142.0	137.5	132.9	128.4	123.8	114.7	105.6	96.4	.....	B-24
129.9	126.1	122.3	118.5	114.6	110.8	103.2	95.6	88.0	.....	B-20-a
145.2	140.8	136.4	132.0	127.6	123.2	114.5	105.7	97.0	.....	B-20
129.7	126.0	122.2	118.5	114.7	111.0	103.4	95.9	88.4	.....	B-20
115.8	111.6	107.4	103.2	99.0	94.8	86.4	78.0	.....	.....	B-20
108.6	104.8	100.9	97.1	93.3	89.4	81.7	74.0	.....	.....	B-20
100.9	97.5	94.0	90.6	87.1	83.7	76.8	69.9	.....	.....	B-20
97.1	93.3	89.5	85.6	81.8	78.0	70.3	62.7	.....	.....	B-18
89.6	86.2	82.8	79.4	76.0	72.6	65.8	59.0	.....	.....	B-18
86.5	83.3	80.0	76.8	73.6	70.4	63.9	57.5	.....	.....	B-18
81.5	78.5	75.6	72.6	69.7	66.7	60.8	54.9	.....	.....	B-15-b
123.1	119.1	115.0	111.0	107.0	102.9	94.8	86.7	.....	.....	B-15-b
104.6	100.5	96.3	92.1	88.0	83.8	75.5	67.2	.....	.....	B-15-a
89.9	86.5	83.1	79.7	76.3	73.0	66.2	59.4	.....	.....	B-15-a
72.1	68.8	65.5	62.2	58.9	55.7	49.1	.....	.....	.....	B-15
65.2	62.4	59.6	56.8	54.0	51.1	45.5	.....	.....	.....	B-15
61.7	59.2	56.6	54.0	51.4	48.8	43.7	.....	.....	.....	B-15
57.8	55.3	52.8	50.4	47.9	45.4	40.5	.....	.....	.....	B-12-a
49.2	46.8	44.4	42.0	39.6	37.2	Allowable stress per square inch: 13,000 pounds for lengths under 55 radii.				B-12
44.7	42.7	40.6	38.6	36.5	34.4					B-12
41.7	39.4	37.1	34.9	32.6	30.3	16,000—55 $\frac{1}{r}$ for lengths over 55 radii.				B-10
35.7	33.9	32.1	30.3	28.5	26.6					B-10

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



Allowable stress per square inch:

13,000 pounds for lengths under 55 radii:

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.

Section Number	Weight of Section, Pounds per Foot	Dimensions, Inches			Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns				
		D	T	B			10 Feet	12 Feet	14 Feet	16 Feet	18 Feet
H-14	83.5	13 $\frac{3}{4}$	1 $\frac{1}{16}$	13.92	24.46	3.47	159.0	159.0	159.0	158.5	153.8
	91.0	13 $\frac{7}{8}$	3 $\frac{3}{4}$	13.96	26.76	3.49	173.9	173.9	173.9	173.9	168.5
	99.0	14	1 $\frac{3}{16}$	14.00	29.06	3.50	188.9	188.9	188.9	188.6	183.2
	106.5	14 $\frac{1}{8}$	7 $\frac{7}{8}$	14.04	31.38	3.52	204.0	204.0	204.0	204.0	198.1
	114.5	14 $\frac{1}{4}$	1 $\frac{5}{16}$	14.08	33.70	3.53	219.1	219.1	219.1	219.1	212.9
	122.5	14 $\frac{3}{8}$	1	14.12	36.04	3.55	234.3	234.3	234.3	234.3	228.0
	130.5	14 $\frac{1}{2}$	1 $\frac{1}{16}$	14.16	38.38	3.56	249.5	249.5	249.5	249.5	243.0
	138.0	14 $\frac{5}{8}$	1 $\frac{1}{8}$	14.19	40.59	3.58	263.8	263.8	263.8	263.8	257.4
	146.0	14 $\frac{3}{4}$	1 $\frac{3}{16}$	14.23	42.95	3.59	279.2	279.2	279.2	279.2	272.5
	154.0	14 $\frac{7}{8}$	1 $\frac{1}{4}$	14.27	45.33	3.61	294.7	294.7	294.7	294.7	288.1
	162.0	15	1 $\frac{5}{16}$	14.31	47.71	3.62	310.1	310.1	310.1	310.1	303.4
	170.5	15 $\frac{1}{8}$	1 $\frac{3}{8}$	14.35	50.11	3.64	325.7	325.7	325.7	325.7	319.0
	178.5	15 $\frac{1}{4}$	1 $\frac{7}{16}$	14.39	52.51	3.65	341.3	341.3	341.3	341.3	334.6
	186.5	15 $\frac{3}{8}$	1 $\frac{1}{2}$	14.43	54.92	3.66	357.0	357.0	357.0	357.0	350.3
	195.0	15 $\frac{1}{2}$	1 $\frac{9}{16}$	14.47	57.35	3.68	372.8	372.8	372.8	372.8	366.1
	203.5	15 $\frac{5}{8}$	1 $\frac{5}{8}$	14.51	59.78	3.69	388.6	388.6	388.6	388.6	381.9
	211.0	15 $\frac{3}{4}$	1 $\frac{11}{16}$	14.54	62.07	3.70	403.5	403.5	403.5	403.5	396.9
	219.5	15 $\frac{7}{8}$	1 $\frac{3}{4}$	14.58	64.52	3.71	419.4	419.4	419.4	419.4	412.9
	227.5	16	1 $\frac{13}{16}$	14.62	66.98	3.72	435.4	435.4	435.4	435.4	429.0
	236.0	16 $\frac{1}{8}$	1 $\frac{7}{8}$	14.66	69.45	3.74	451.4	451.4	451.4	451.4	445.2
	244.5	16 $\frac{1}{4}$	1 $\frac{15}{16}$	14.70	71.94	3.75	467.6	467.6	467.6	467.6	461.5
	253.0	16 $\frac{3}{8}$	2	14.74	74.43	3.76	483.8	483.8	483.8	483.8	477.9
	261.5	16 $\frac{1}{2}$	2 $\frac{1}{16}$	14.78	76.93	3.77	500.0	500.0	500.0	500.0	494.4
	270.0	16 $\frac{5}{8}$	2 $\frac{3}{8}$	14.82	79.44	3.79	516.4	516.4	516.4	516.4	510.9
	278.5	16 $\frac{3}{4}$	2 $\frac{3}{16}$	14.86	81.97	3.80	532.8	532.8	532.8	532.8	527.6
	287.5	16 $\frac{7}{8}$	2 $\frac{1}{4}$	14.90	84.50	3.81	549.3	549.3	549.3	549.3	544.3

For detail dimensions, see page 52.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS

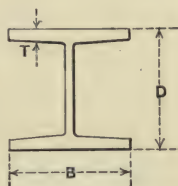
IN TONS OF 2000 POUNDS

SQUARE ENDS

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.



Unsupported Length of Columns

Weight of
Section,
Pounds
per Foot

20 Feet	22 Feet	24 Feet	26 Feet	28 Feet	30 Feet	32 Feet	36 Feet	40 Feet	44 Feet	
149.2	144.5	139.9	135.2	130.5	125.9	121.2	111.9	102.6		83.5
163.4	158.4	153.3	148.2	143.2	138.1	133.1	122.9	112.8		91.0
177.7	172.2	166.7	161.2	155.8	150.3	144.8	133.8	122.9	111.9	99.0
192.2	186.3	180.4	174.6	168.7	162.8	156.9	145.1	133.4	121.6	106.5
206.6	200.3	194.0	187.7	181.4	175.1	168.8	156.2	143.6	131.0	114.5
221.3	214.6	207.9	201.2	194.5	187.8	181.1	167.7	154.3	140.9	122.5
235.9	228.8	221.7	214.5	207.4	200.3	193.2	179.0	164.7	150.5	130.5
249.9	242.4	234.9	227.4	220.0	212.5	205.0	190.0	175.1	160.1	138.0
264.6	256.7	248.9	241.0	233.1	225.2	217.3	201.5	185.7	170.0	146.0
279.8	271.5	263.2	254.9	246.6	238.3	230.0	213.5	196.9	180.3	154.0
294.7	286.0	277.3	268.6	259.9	251.2	242.5	225.1	207.7	190.3	162.0
309.9	300.8	291.7	282.6	273.5	264.4	255.3	237.1	218.9	200.7	170.5
325.1	315.6	306.1	296.6	287.1	277.6	268.1	249.1	230.1	211.1	178.5
340.4	330.5	320.6	310.7	300.8	290.9	281.0	261.2	241.4	221.6	186.5
355.8	345.5	335.2	324.9	314.6	304.3	294.0	273.4	252.8	232.2	195.0
371.2	360.5	349.8	339.1	328.4	317.7	307.0	285.6	264.2	242.8	203.5
385.8	374.8	363.7	352.6	341.6	330.5	319.4	297.3	275.1	253.0	211.0
401.4	390.0	378.5	367.1	355.6	344.1	332.6	309.7	286.8	263.8	219.5
417.2	405.3	393.4	381.6	369.7	357.8	345.9	322.2	298.5	274.8	227.5
433.0	420.7	408.4	396.2	383.9	371.6	359.4	334.8	310.3	285.8	236.0
448.9	436.2	423.6	410.9	398.2	385.6	372.9	347.6	322.2	296.9	244.5
464.8	451.8	438.7	425.7	412.6	399.6	386.5	360.4	334.3	308.1	253.0
480.9	467.4	454.0	440.5	427.1	413.6	400.2	373.3	346.4	319.5	261.5
497.0	483.2	469.3	455.5	441.6	427.8	413.9	386.3	358.6	330.9	270.0
513.3	499.1	484.8	470.6	456.3	442.1	427.8	399.4	370.9	342.4	278.5
529.6	515.0	500.4	485.7	471.1	456.4	441.8	412.5	383.3	354.0	287.5

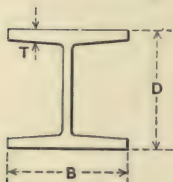
Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

12-INCH H-COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.

Section Number	Weight of Section, Pounds per Foot	Dimensions, Inches			Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns				
		D	T	B			10 Feet	12 Feet	14 Feet	16 Feet	18 Feet
H-12	64.5	$11\frac{3}{4}$	$\frac{5}{8}$	11.92	19.00	2.98	123.5	123.5	122.5	118.3	114.1
	71.5	$11\frac{7}{8}$	$1\frac{1}{16}$	11.96	20.96	3.00	136.2	136.2	135.4	130.8	126.2
	78.0	12	$\frac{3}{4}$	12.00	22.94	3.01	149.1	149.1	148.3	143.3	138.3
	84.5	$12\frac{1}{8}$	$1\frac{3}{16}$	12.04	24.92	3.03	162.0	162.0	161.4	155.9	150.5
	91.5	$12\frac{1}{4}$	$\frac{7}{8}$	12.08	26.92	3.04	175.0	175.0	174.5	168.6	162.8
	98.5	$12\frac{3}{8}$	$1\frac{5}{16}$	12.12	28.92	3.06	188.0	188.0	187.7	181.5	175.2
	105.0	$12\frac{1}{2}$	1	12.16	30.94	3.07	201.1	201.1	201.0	194.3	187.7
	112.0	$12\frac{5}{8}$	$1\frac{1}{16}$	12.20	32.96	3.08	214.2	214.2	214.2	207.2	200.1
	118.5	$12\frac{3}{4}$	$1\frac{1}{8}$	12.23	34.87	3.10	226.7	226.7	226.7	219.6	212.1
	125.5	$12\frac{7}{8}$	$1\frac{3}{16}$	12.27	36.91	3.11	239.9	239.9	239.9	232.6	224.8
	132.5	13	$1\frac{1}{4}$	12.31	38.97	3.13	253.3	253.3	253.3	246.0	237.8
	139.5	$13\frac{1}{8}$	$1\frac{5}{16}$	12.35	41.03	3.14	266.7	266.7	266.7	259.3	250.6
	146.5	$13\frac{1}{4}$	$1\frac{3}{8}$	12.39	43.10	3.15	280.2	280.2	280.2	272.6	263.5
	153.5	$13\frac{3}{8}$	$1\frac{7}{16}$	12.43	45.19	3.16	293.7	293.7	293.7	286.0	276.6
	161.0	$13\frac{1}{2}$	$1\frac{1}{2}$	12.47	47.28	3.18	307.3	307.3	307.3	299.7	289.9

For detail dimensions, see page 54.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

12-INCH H-COLUMNS

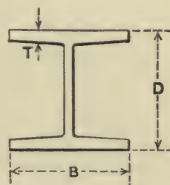
IN TONS OF 2000 POUNDS

SQUARE ENDS

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.



Unsupported Length of Columns										Weight of Section, Pounds per Foot
20 Feet	22 Feet	24 Feet	26 Feet	28 Feet	30 Feet	32 Feet	34 Feet	36 Feet	38 Feet	
109.9	105.7	101.5	97.3	93.1	88.9	84.7	80.5	76.3		64.5
121.6	117.0	112.4	107.8	103.1	98.5	93.9	89.3	84.7		71.5
133.2	128.2	123.2	118.1	113.1	108.1	103.0	98.0	93.0		78.0
145.1	139.7	134.2	128.8	123.4	117.9	112.5	107.1	101.7		84.5
156.9	151.1	145.2	139.4	133.5	127.7	121.9	116.0	110.2	104.3	91.5
169.0	162.8	156.5	150.3	144.0	137.8	131.6	125.3	119.1	112.8	98.5
181.0	174.4	167.7	161.1	154.4	147.8	141.1	134.4	127.8	121.1	105.0
193.1	186.0	178.9	171.9	164.8	157.7	150.7	143.6	136.6	129.5	112.0
204.7	197.3	189.9	182.5	175.0	167.6	160.2	152.8	145.3	137.9	118.5
217.0	209.1	201.3	193.5	185.6	177.8	170.0	162.1	154.3	146.5	125.5
229.6	221.4	213.2	204.9	196.7	188.5	180.3	172.1	163.9	155.6	132.5
242.0	233.4	224.8	216.1	207.5	198.9	190.3	181.6	173.0	164.4	139.5
254.5	245.5	236.4	227.4	218.4	209.3	200.3	191.3	182.3	173.2	146.5
267.1	257.7	248.3	238.8	229.4	219.9	210.5	201.1	191.6	182.2	153.5
280.1	270.3	260.5	250.7	240.9	231.0	221.2	211.4	201.6	191.8	161.0

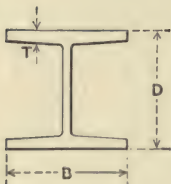
Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

10-INCH H-COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.

Section Number	Weight of Section, Pounds per Foot	Dimensions, Inches			Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns				
		D	T	B			10 Feet	11 Feet	12 Feet	13 Feet	14 Feet
H-10	49.0	9 $\frac{7}{8}$	9 $\frac{9}{16}$	9.97	14.37	2.49	93.5	93.5	92.1	90.2	88.3
	54.0	10	5 $\frac{5}{8}$	10.00	15.91	2.51	103.4	103.4	102.2	100.1	98.0
	59.5	10 $\frac{1}{8}$	11 $\frac{1}{16}$	10.04	17.57	2.53	114.2	114.2	113.1	110.8	108.5
	65.5	10 $\frac{1}{4}$	3 $\frac{3}{4}$	10.08	19.23	2.54	125.0	125.0	123.9	121.4	118.9
	71.0	10 $\frac{3}{8}$	13 $\frac{1}{16}$	10.12	20.91	2.56	135.9	135.9	134.9	132.2	129.5
	77.0	10 $\frac{1}{2}$	7 $\frac{7}{8}$	10.16	22.59	2.57	146.8	146.8	145.9	143.0	140.1
	82.5	10 $\frac{5}{8}$	15 $\frac{1}{16}$	10.20	24.29	2.58	157.9	157.9	157.0	153.9	150.8
	88.5	10 $\frac{3}{4}$	1	10.24	25.99	2.60	168.9	168.9	168.3	165.0	161.7
	94.0	10 $\frac{7}{8}$	11 $\frac{1}{16}$	10.28	27.71	2.61	180.1	180.1	179.6	176.1	172.6
	99.5	11	1 $\frac{1}{8}$	10.31	29.32	2.62	190.6	190.6	190.2	186.6	182.9
	105.5	11 $\frac{1}{8}$	13 $\frac{1}{16}$	10.35	31.06	2.64	201.9	201.9	201.9	198.0	194.1
	111.5	11 $\frac{1}{4}$	1 $\frac{1}{4}$	10.39	32.80	2.65	213.2	213.2	213.2	209.3	205.2
	117.5	11 $\frac{3}{8}$	15 $\frac{1}{16}$	10.43	34.55	2.66	224.6	224.6	224.6	220.7	216.4
	123.5	11 $\frac{1}{2}$	13 $\frac{1}{8}$	10.47	36.32	2.67	236.1	236.1	236.1	232.2	227.7

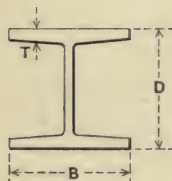
For detail dimensions, see page 56.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

10-INCH H-COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55\frac{1}{r}$ for lengths over 55 radii.

Unsupported Length of Columns										Weight of Section, Pounds per Foot
15 Feet	16 Feet	18 Feet	20 Feet	22 Feet	24 Feet	26 Feet	28 Feet	30 Feet	32 Feet	
86.3	84.5	80.7	76.9	73.1	69.3	65.4	61.6	57.8	54.0	49.0
95.9	93.8	89.6	85.4	81.3	77.1	72.9	68.7	64.5	60.3	54.0
106.2	103.9	99.3	94.7	90.1	85.6	81.0	76.4	71.8	67.2	59.5
116.4	113.9	108.9	103.9	98.9	93.9	88.9	83.9	78.9	73.9	65.5
126.9	124.2	118.8	113.4	108.0	102.6	97.2	91.8	86.4	80.1	71.0
137.2	134.3	128.5	122.7	116.9	111.1	105.3	99.5	93.7	87.9	77.0
147.7	144.6	138.4	132.2	126.0	119.8	113.5	107.3	101.1	94.9	82.5
158.4	155.1	148.5	142.0	135.4	128.8	122.2	115.6	109.0	102.4	88.5
169.1	165.6	158.6	151.6	144.6	137.6	130.6	123.6	116.6	109.6	94.0
179.2	175.5	168.1	160.7	153.3	145.9	138.5	131.2	123.8	116.4	99.5
190.3	186.4	178.6	170.8	163.1	155.3	147.5	139.8	132.0	124.2	105.5
201.2	197.0	188.9	180.7	172.5	164.4	156.2	148.0	139.9	131.7	111.5
212.1	207.8	199.2	190.7	182.1	173.5	165.0	156.4	147.8	139.2	117.5
223.2	218.7	209.8	200.8	191.8	182.8	173.8	164.9	155.9	146.9	123.5

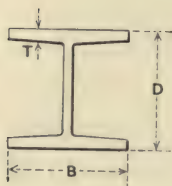
Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

8-INCH H-COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.

Section Number	Weight of Section, Pounds per Foot	Dimensions, Inches			Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns				
		D	T	B			8 Feet	9 Feet	10 Feet	11 Feet	12 Feet
H-8	32.0	$7\frac{7}{8}$	$\frac{7}{16}$	8.00	9.17	1.98	59.7	59.7	58.1	56.5	55.0
	34.5	8	$\frac{1}{2}$	8.00	10.17	2.01	66.1	66.1	64.7	63.0	61.3
	39.0	$8\frac{1}{8}$	$\frac{9}{16}$	8.04	11.50	2.03	74.8	74.8	73.3	71.4	69.6
	43.5	$8\frac{1}{4}$	$\frac{5}{8}$	8.08	12.83	2.04	83.4	83.4	81.9	79.8	77.7
	48.0	$8\frac{3}{8}$	$\frac{11}{16}$	8.12	14.18	2.05	92.2	92.2	90.6	88.3	86.1
	53.0	$8\frac{1}{2}$	$\frac{3}{4}$	8.16	15.53	2.07	101.0	101.0	99.5	97.0	94.5
	57.5	$8\frac{5}{8}$	$\frac{13}{16}$	8.20	16.90	2.08	109.9	109.9	108.4	105.7	103.0
	62.0	$8\frac{3}{4}$	$\frac{7}{8}$	8.24	18.27	2.09	118.8	118.8	117.3	114.4	111.5
	67.0	$8\frac{7}{8}$	$\frac{15}{16}$	8.28	19.66	2.11	127.8	127.8	126.5	123.5	120.4
	71.5	9	1	8.32	21.05	2.12	136.8	136.8	135.6	132.4	129.1
	76.5	$9\frac{1}{8}$	$\frac{11}{16}$	8.36	22.46	2.13	146.0	146.0	144.9	141.4	137.9
	81.0	$9\frac{1}{4}$	$\frac{1}{8}$	8.39	23.78	2.14	154.6	154.6	153.6	149.9	146.2
	85.5	$9\frac{3}{8}$	$\frac{13}{16}$	8.43	25.20	2.16	163.8	163.8	163.1	159.3	155.4
	90.5	$9\frac{1}{2}$	$\frac{11}{4}$	8.47	26.64	2.17	173.2	173.2	172.6	168.6	164.5

For detail dimensions, see page 58.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL

8-INCH H-COLUMNS

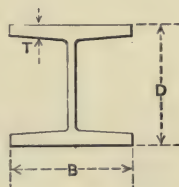
IN TONS OF 2000 POUNDS

SQUARE ENDS

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55 \frac{1}{r}$ for lengths over 55 radii.



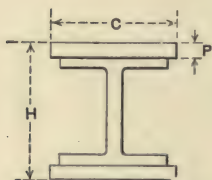
Unsupported Length of Columns										Weight of Section, Pounds per Foot
13 Feet	14 Feet	15 Feet	16 Feet	17 Feet	18 Feet	20 Feet	22 Feet	24 Feet	26 Feet	
53.5	52.0	50.4	48.9	47.4	45.9	42.8	39.7	36.7		32.0
59.7	58.0	56.3	54.6	53.0	51.3	48.0	44.6	41.3	38.0	34.5
67.7	65.8	64.0	62.1	60.2	58.4	54.6	50.9	47.1	43.4	39.0
75.7	73.6	71.5	69.4	67.4	65.3	61.1	57.0	52.8	48.7	43.5
83.8	81.5	79.2	76.9	74.6	72.4	67.8	63.2	58.7	54.1	48.0
92.1	89.6	87.1	84.6	82.2	79.7	74.7	69.8	64.8	59.9	53.0
100.3	97.7	95.0	92.3	89.6	86.9	81.6	76.2	70.9	65.5	57.5
108.7	105.8	102.9	100.0	97.1	94.2	88.5	82.7	76.9	71.2	62.0
117.3	114.2	111.2	108.1	105.0	101.9	95.8	89.6	83.5	77.3	67.0
125.8	122.5	119.2	116.0	112.7	109.4	102.9	96.3	89.8	83.2	71.5
134.4	131.0	127.5	124.0	120.5	117.0	110.1	103.1	96.2	89.2	76.5
142.6	138.9	135.2	131.6	127.9	124.2	116.9	109.6	102.2	94.9	81.0
151.6	147.7	143.9	140.0	136.1	132.3	124.6	116.9	109.2	101.5	85.5
160.5	156.4	152.4	148.3	144.3	140.2	132.1	124.0	115.9	107.8	90.5

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR COMPOUND COLUMNS

IN TONS OF 2000 POUNDS

SQUARE ENDS



14" x 148-pound Special H-Column Section
Reinforced with Cover Plates

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000— $55\frac{1}{r}$ for lengths over 55 radii

Section	Weight of Section, Lbs. per Foot	Dimensions, Inches			Area of Section, Square Inches	Least Radius of Gyration, Inches	Unsupported Length of Columns				
		C	P	H			12 Feet	14 Feet	16 Feet	18 Feet	20 Feet
Columns composed of a 14" x 148-pound Special Column Section, (Section H-14-b), reinforced with cover plates of width and thickness given in table.	284.0	16	1 $\frac{1}{4}$	16 $\frac{5}{8}$	83.52	3.98	542.9	542.9	542.9	542.9	529.7
	290.8	16	1 $\frac{5}{16}$	16 $\frac{3}{4}$	85.52	3.99	555.9	555.9	555.9	555.9	542.7
	297.6	16	1 $\frac{3}{8}$	16 $\frac{7}{8}$	87.52	4.01	568.9	568.9	568.9	568.9	556.1
	304.4	16	1 $\frac{7}{16}$	17	89.52	4.02	581.9	581.9	581.9	581.9	569.2
	311.2	16	1 $\frac{1}{2}$	17 $\frac{1}{8}$	91.52	4.04	594.9	594.9	594.9	594.9	582.6
	318.0	16	1 $\frac{9}{16}$	17 $\frac{1}{4}$	93.52	4.05	607.9	607.9	607.9	607.9	595.8
	324.8	16	1 $\frac{5}{8}$	17 $\frac{3}{8}$	95.52	4.06	620.9	620.9	620.9	620.9	608.9
	331.6	16	1 $\frac{11}{16}$	17 $\frac{1}{2}$	97.52	4.08	633.9	633.9	633.9	633.9	622.4
	338.4	16	1 $\frac{3}{4}$	17 $\frac{5}{8}$	99.52	4.09	646.9	646.9	646.9	646.9	635.6
	345.2	16	1 $\frac{15}{16}$	17 $\frac{3}{4}$	101.52	4.10	659.9	659.9	659.9	659.9	648.7
	350.3	17	1 $\frac{3}{4}$	17 $\frac{5}{8}$	103.02	4.30	669.6	669.6	669.6	669.6	666.0
	357.5	17	1 $\frac{13}{16}$	17 $\frac{3}{4}$	105.15	4.31	683.5	683.5	683.5	683.5	680.2
	364.7	17	1 $\frac{7}{8}$	17 $\frac{7}{8}$	107.27	4.32	697.3	697.3	697.3	697.3	694.3
	372.0	17	1 $\frac{15}{16}$	18	109.40	4.33	711.1	711.1	711.1	711.1	708.4
	379.2	17	2	18 $\frac{1}{8}$	111.52	4.35	724.9	724.9	724.9	724.9	723.0
	386.4	17	2 $\frac{1}{16}$	18 $\frac{1}{4}$	113.65	4.36	738.7	738.7	738.7	738.7	737.2
	393.6	17	2 $\frac{1}{8}$	18 $\frac{3}{8}$	115.77	4.37	752.5	752.5	752.5	752.5	751.3
	400.9	17	2 $\frac{3}{16}$	18 $\frac{1}{2}$	117.90	4.38	766.4	766.4	766.4	766.4	765.5
	408.1	17	2 $\frac{1}{4}$	18 $\frac{5}{8}$	120.02	4.39	780.1	780.1	780.1	780.1	779.7
	415.3	17	2 $\frac{5}{16}$	18 $\frac{3}{4}$	122.15	4.40	794.0	794.0	794.0	794.0	794.0
	423.4	18	2 $\frac{1}{4}$	18 $\frac{5}{8}$	124.52	4.62	809.4	809.4	809.4	809.4	809.4
	431.0	18	2 $\frac{5}{16}$	18 $\frac{3}{4}$	126.77	4.63	824.0	824.0	824.0	824.0	824.0
	438.7	18	2 $\frac{3}{8}$	18 $\frac{7}{8}$	129.02	4.64	838.6	838.6	838.6	838.6	838.6
	446.3	18	2 $\frac{7}{16}$	19	131.27	4.65	853.3	853.3	853.3	853.3	853.3
	454.0	18	2 $\frac{1}{2}$	19 $\frac{1}{8}$	133.52	4.66	867.9	867.9	867.9	867.9	867.9
	461.6	18	2 $\frac{9}{16}$	19 $\frac{1}{4}$	135.77	4.67	882.5	882.5	882.5	882.5	882.5
	469.3	18	2 $\frac{5}{8}$	19 $\frac{3}{8}$	138.02	4.68	897.1	897.1	897.1	897.1	897.1
	476.9	18	2 $\frac{11}{16}$	19 $\frac{1}{2}$	140.27	4.69	911.8	911.8	911.8	911.8	911.8
	484.6	18	2 $\frac{3}{4}$	19 $\frac{5}{8}$	142.52	4.70	926.4	926.4	926.4	926.4	926.4

For detail dimensions, see page 70.

SAFE LOADS FOR COMPOUND COLUMNS

IN TONS OF 2000 POUNDS

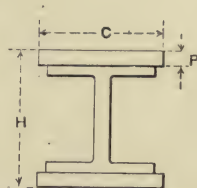
SQUARE ENDS

14" x 148-pound Special H-Column Section
Reinforced with Cover Plates

Allowable stress per square inch:

13,000 pounds for lengths under 55 radii.

16,000 — $55\frac{1}{r}$ for lengths over 55 radii.



Unsupported Length of Columns										Cover Plates	
22 Feet	24 Feet	26 Feet	28 Feet	30 Feet	32 Feet	36 Feet	40 Feet	44 Feet	48 Feet	Width, Inches C	Thick- ness, Inches P
515.8	502.0	488.1	474.3	460.4	446.6	418.9	391.2	363.5	335.8	16	1 1/4
528.6	514.4	500.3	486.1	472.0	457.8	429.5	401.2	372.9	344.7	16	1 5/16
541.7	527.3	512.9	498.5	484.1	469.7	440.9	412.1	383.3	354.4	16	1 3/8
554.5	539.8	525.1	510.4	495.7	481.0	451.6	422.2	392.8	363.4	16	1 7/16
567.7	552.7	537.8	522.8	507.9	492.9	463.0	433.1	403.2	373.3	16	1 1/2
580.5	565.3	550.0	534.8	519.6	504.3	473.8	443.4	412.9	382.4	16	1 9/16
593.4	577.8	562.3	546.8	531.2	515.7	484.7	453.6	422.5	391.5	16	1 5/8
606.6	590.9	575.1	559.3	543.5	527.8	496.2	464.7	433.1	401.6	16	1 11/16
619.5	603.4	587.4	571.3	555.3	539.2	507.1	475.0	442.9	410.7	16	1 3/4
632.4	616.1	599.7	583.4	567.0	550.7	518.0	485.3	452.6	419.9	16	1 13/16
650.2	634.4	618.6	602.8	587.0	571.2	539.5	507.9	476.3	444.7	17	1 3/4
664.1	648.0	631.9	615.8	599.7	583.6	551.4	519.2	487.0	454.8	17	1 13/16
677.9	661.5	645.1	628.7	612.3	595.9	563.2	530.4	497.6	464.8	17	1 7/8
691.8	675.1	658.4	641.7	625.1	608.4	575.0	541.7	508.3	475.0	17	1 15/16
706.0	689.1	672.2	655.3	638.4	621.4	587.6	553.8	519.9	486.1	17	2
720.0	702.8	685.5	668.3	651.1	633.9	599.5	565.1	530.7	496.3	17	2 1/16
733.8	716.3	698.9	681.4	663.9	646.4	611.4	576.5	541.5	506.5	17	2 1/8
747.8	730.0	712.2	694.5	676.7	658.9	623.4	587.9	552.4	516.8	17	2 3/16
761.7	743.6	725.6	707.5	689.5	671.5	635.4	599.3	563.2	527.1	17	2 1/4
775.7	757.3	739.0	720.7	702.4	684.0	647.4	610.8	574.1	537.5	17	2 5/16
800.5	782.7	764.9	747.1	729.3	711.5	676.0	640.4	604.8	569.2	18	2 1/4
815.4	797.3	779.2	761.2	743.1	725.0	688.9	652.7	616.6	580.5	18	2 5/16
830.3	811.9	793.6	775.2	756.9	738.5	701.8	665.1	628.4	591.7	18	2 3/8
845.2	826.6	807.9	789.3	770.7	752.0	714.8	677.5	640.3	603.0	18	2 7/16
860.1	841.2	822.3	803.4	784.5	765.6	727.8	689.9	652.1	614.3	18	2 1/2
875.1	855.9	836.7	817.5	798.3	779.2	740.8	702.4	664.0	625.6	18	2 9/16
890.1	870.6	851.1	831.7	812.2	792.7	753.8	714.9	675.9	637.0	18	2 5/8
905.0	885.3	865.5	845.8	826.1	806.3	766.8	727.4	687.9	648.4	18	2 11/16
920.0	900.0	880.0	860.0	840.0	819.9	779.9	739.9	699.9	659.8	18	2 3/4

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED GIRDER BEAMS USED AS COLUMNS IN TONS OF 1000 KILOGRAMS SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.

Num- ber of Section	Depth of Beam	Weight per Meter	Area of Section	Least Radius of Gy- ration	Unsupported Length of Columns, in Meters					
	Mm.	Kg.	Cm. ²	Cm.	2.5	3.0	3.5	4.0	4.5	5.0
G-30-a	762	297.6	378.8	8.33	350.4	350.4	350.4	350.4	347.0	338.2
G-30	762	267.9	341.9	7.26	316.3	316.3	316.3	311.7	302.6	293.5
G-28	711	245.6	312.7	7.04	289.2	289.2	289.2	283.0	274.4	265.8
G-26-a	660	238.1	302.6	7.75	279.9	279.9	279.9	279.9	272.4	264.9
G-26	660	223.2	283.5	6.81	262.2	262.2	262.2	254.5	246.4	238.4
G-24-a	610	208.3	265.5	7.37	245.6	245.6	245.6	242.9	236.0	229.0
G-24	610	178.6	228.3	6.76	211.2	211.2	211.1	204.6	198.0	191.5
G-20-a	508	208.3	265.7	7.39	245.8	245.8	245.8	243.3	236.3	229.3
G-20	508	166.7	211.7	6.86	195.8	195.8	195.8	190.4	184.4	178.5
G-18	457	136.9	175.0	6.58	161.9	161.9	160.9	155.7	150.6	145.4
G-15-b	381	208.3	266.3	7.19	246.3	246.3	246.3	242.3	235.1	227.9
G-15-a	381	154.8	196.8	6.71	182.0	182.0	181.7	176.0	170.3	164.6
G-15	381	108.6	138.6	6.07	128.2	128.2	125.0	120.6	116.2	111.7
G-12-a	305	104.2	132.8	5.99	122.8	122.8	119.4	115.1	110.8	106.5
G-12	305	81.9	104.4	5.69	96.6	96.1	92.6	89.0	85.5	81.9
G-10	254	65.5	83.5	5.33	77.2	75.7	72.7	69.7	66.7	63.6
G-9	229	56.6	72.4	5.03	67.0	64.7	62.0	59.2	56.4	53.6
G-8	203	48.4	61.5	4.72	56.6	54.1	51.5	49.0	46.5	44.0

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS FOR BETHLEHEM ROLLED GIRDER BEAMS USED AS COLUMNS IN TONS OF 1000 KILOGRAMS SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

1125— $3.87\frac{1}{r}$ for lengths over 52 radii.

Unsupported Length of Columns, in Meters										Number of Section
5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	
329.4	320.6	311.8	303.0	294.2	285.4	276.6	267.8	259.0	250.2	G-30-a
284.4	275.3	266.2	257.1	247.9	238.8	229.7	220.6	211.5	202.4	G-30
257.2	248.6	240.1	231.5	222.9	214.3	205.7	197.1	188.5	179.9	G-28
257.3	249.8	242.2	234.7	227.1	219.5	212.0	204.4	196.9	189.3	G-26-a
230.3	222.3	214.2	206.2	198.1	190.1	182.0	173.9	165.9	157.8	G-26
222.0	215.0	208.1	201.1	194.1	187.2	180.2	173.2	166.2	159.3	G-24-a
185.0	178.4	171.9	165.3	158.8	152.3	145.7	139.2	132.7	126.1	G-24
222.4	215.4	208.5	201.5	194.6	187.6	180.6	173.7	166.7	159.8	G-20-a
172.5	166.5	160.5	154.6	148.6	142.6	136.7	130.7	124.7	118.7	G-20
140.3	135.1	130.0	124.8	119.7	114.5	109.4	104.2	99.1	.....	G-18
220.8	213.6	206.4	199.3	192.1	184.9	177.8	170.6	163.4	156.3	G-15-b
159.0	153.3	147.6	141.9	136.3	130.6	124.9	119.2	113.6	107.9	G-15-a
107.3	102.9	93.5	94.1	89.7	85.2	80.8	76.4	.....	.....	G-15
102.2	97.9	93.6	89.3	85.1	80.8	76.5	.....	.....	.....	G-12-a
78.4	74.8	71.3	67.7	64.2	60.6	57.1	.....	.....	.....	G-12
60.6	57.6	54.5	51.5	48.5	45.4	.....	.....	.....	.....	G-10
50.8	48.0	45.2	42.5	39.7	.....	.....	.....	.....	.....	G- 9
41.5	38.9	36.4	33.9	.....	.....	.....	.....	.....	.....	G- 8

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS FOR BETHLEHEM I-BEAMS USED AS COLUMNS IN TONS OF 1000 KILOGRAMS SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.

Number of Section	Depth of Beam	Weight per Meter	Area of Section	Least Radius of Gyration	Unsupported Length of Columns, in Meters			
	Mm.	Kg.	Cm. ²	Cm.	1.5	2.0	2.5	3.0
B-30	762	178.6	227.7	5.49	210.6	210.6	210.6	208.0
B-28	711	156.3	199.2	5.23	184.3	184.3	184.3	199.9
B-26	660	133.9	170.9	4.95	158.1	158.1	158.1	152.2
B-24-a	610	125.0	160.0	4.88	148.0	148.0	148.0	141.9
B-24	610	123.5	158.6	4.52	146.7	146.7	144.5	137.7
	610	108.6	138.5	4.72	128.1	128.1	127.4	121.7
B-20-a	508	122.0	155.9	4.62	144.2	144.2	142.7	136.2
	508	107.2	137.9	4.78	127.6	127.6	127.2	121.6
B-20	508	102.7	130.7	4.04	120.9	120.9	115.7	109.5
	508	95.2	121.7	4.11	112.6	112.6	108.3	102.5
	508	87.8	112.0	4.22	103.6	103.6	100.3	95.2
B-18	457	87.8	112.3	3.81	103.9	103.5	97.8	92.1
	457	80.4	102.4	3.91	94.7	94.7	89.9	84.8
	457	77.4	98.3	3.96	90.9	90.9	86.6	81.8
	457	72.2	91.9	4.04	85.0	85.0	81.4	77.0
B-15-b	381	105.7	135.2	4.34	125.1	125.1	122.0	115.9
B-15-a	381	95.2	121.4	3.78	112.3	111.7	105.5	99.3
	381	80.4	102.5	3.94	94.8	94.8	90.1	85.1
B-15	381	68.5	87.2	3.45	80.7	78.5	73.6	68.8
	381	61.0	77.5	3.58	71.7	70.4	66.2	62.1
	381	56.6	72.7	3.66	67.2	66.4	62.6	58.7
B-12-a	305	53.6	68.5	3.61	63.4	62.4	58.7	55.0
B-12	305	47.6	60.9	3.30	56.3	54.2	50.7	47.1
	305	42.4	54.3	3.43	50.2	48.8	45.8	42.7
B-10	254	42.4	53.8	3.07	49.8	47.0	43.6	40.2
	254	35.0	44.8	3.23	41.4	39.7	37.0	34.3

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS FOR BETHLEHEM I-BEAMS USED AS COLUMNS IN TONS OF 1000 KILOGRAMS SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

1125— $3.87\frac{1}{r}$ for lengths over 52 radii.

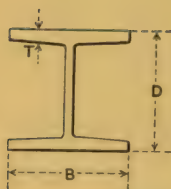
Unsupported Length of Columns, in Meters								Number of Section
3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	
200.0	192.0	183.9	175.9	167.9	159.9	151.8	143.8	B-30
172.5	165.1	157.8	150.4	143.0	135.7	128.3	120.9	B-28
145.5	138.8	132.1	125.5	118.8	112.1	105.4	98.7	B-26
135.6	129.2	122.9	116.6	110.2	103.9	97.5	91.2	B-24-
130.9	124.1	117.3	110.5	103.7	97.0	90.2	.....	B-24
116.1	110.4	104.7	99.0	93.4	87.7	82.0	76.3	B-20-a
129.7	123.2	116.6	110.1	103.6	97.0	90.5	.....	
116.1	110.5	104.9	99.3	93.7	88.1	82.6	77.0	
103.2	97.0	90.7	84.4	78.2	71.9	.....	.....	B-20
96.8	91.1	85.3	79.6	73.9	68.2	.....	.....	
90.1	84.9	79.8	74.6	69.5	64.4	.....	.....	
86.4	80.7	75.0	69.3	63.6	.....	.....	.....	
79.7	74.7	69.6	64.5	59.5	.....	.....	.....	B-18
77.0	72.2	67.4	62.6	57.8	.....	.....	.....	
72.6	68.2	63.8	59.4	55.0	50.6	.....	.....	
109.9	103.9	97.8	91.8	85.8	79.8	73.7	.....	B-15-b
93.1	86.9	80.6	74.4	68.2	.....	.....	.....	B-15-a
80.1	75.0	70.0	65.0	59.9	.....	.....	.....	
63.9	59.0	54.1	49.2	.....	.....	.....	.....	B-15
57.9	53.7	49.5	45.3	.....	.....	.....	.....	
54.9	51.0	47.2	43.4	.....	.....	.....	.....	
51.4	47.7	44.0	40.3	.....	.....	.....	.....	B-12-a
43.5	39.9	36.4	.....	.....	.....	.....	.....	B-12
39.6	36.6	33.5	30.5	.....	.....	.....	.....	
36.8	33.4	30.0	.....	.....	.....	.....	.....	B-10
31.6	28.9	26.2	.....	.....	.....	.....	.....	

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS

IN TONS OF 1000 KILOGRAMS

SQUARE ENDS



Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.

Num- ber of Sec- tion	Weight of Sec- tion, Kg. per Meter	Dimensions in Millimeters			Area of Sec- tion in Cm. ²	Least Radius of Gy- ration, Cm.	Unsupported Length of Columns, in Meters				
		D	T	B			3.0	3.5	4.0	4.5	5.0
H-14	124.3	350	17.6	354	157.8	8.81	146.0	146.0	146.0	146.0	142.9
	135.4	353	19.1	355	172.6	8.86	159.7	159.7	159.7	159.7	156.5
	147.3	356	20.6	356	187.5	8.89	173.4	173.4	173.4	173.4	170.1
	158.5	359	22.1	357	202.5	8.94	187.3	187.3	187.3	187.3	184.0
	170.4	362	23.6	358	217.4	8.97	201.1	201.1	201.1	201.1	197.7
	182.3	366	25.6	359	232.5	9.02	215.1	215.1	215.1	215.1	211.7
	194.2	369	27.1	360	247.6	9.04	229.0	229.0	229.0	229.0	225.6
	205.4	372	28.6	361	261.9	9.09	242.3	242.3	242.3	242.3	238.9
	217.3	375	30.1	362	277.1	9.12	256.3	256.3	256.3	256.3	252.9
	229.2	378	31.6	363	292.5	9.17	270.6	270.6	270.6	270.6	267.3
	241.1	381	33.1	364	307.8	9.19	284.7	284.7	284.7	284.7	281.5
	253.7	385	35.1	365	323.3	9.25	299.1	299.1	299.1	299.1	296.1
	265.6	388	36.6	366	338.8	9.27	313.4	313.4	313.4	313.4	310.4
	277.5	391	38.1	367	354.3	9.30	327.7	327.7	327.7	327.7	324.9
	290.2	394	39.6	368	370.0	9.35	342.3	342.3	342.3	342.3	339.7
	302.8	397	41.1	369	385.7	9.37	356.8	356.8	356.8	356.8	354.3
	314.0	401	43.1	370	400.5	9.40	370.5	370.5	370.5	370.5	368.1
	326.7	404	44.6	371	416.3	9.42	385.1	385.1	385.1	385.1	382.8
	338.6	407	46.1	372	432.1	9.45	399.7	399.7	399.7	399.7	397.6
	351.2	410	47.6	373	448.1	9.50	414.5	414.5	414.5	414.5	412.8
	363.9	413	49.1	374	464.1	9.53	429.3	429.3	429.3	429.3	427.9
	376.5	416	50.6	375	480.2	9.55	444.2	444.2	444.2	444.2	442.9
	389.2	420	52.6	376	496.3	9.58	459.1	459.1	459.1	459.1	458.1
	401.8	423	54.1	377	512.5	9.63	474.1	474.1	474.1	474.1	473.6
	414.5	426	55.6	378	528.8	9.65	489.1	489.1	489.1	489.1	488.9
	427.9	429	57.1	379	545.2	9.68	504.3	504.3	504.3	504.3	504.3

For detail dimensions see page 60.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 14-INCH H-COLUMNS

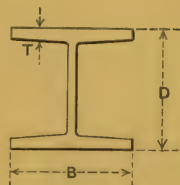
IN TONS OF 1000 KILOGRAMS

SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

1125— $3.87 \frac{1}{r}$ for lengths over 52 radii.



Unsupported Length of Columns, in Meters

Weight
of
Section,
Kilo-
grams
per
Meter

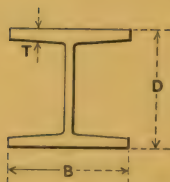
5.5	6.0	6.5	7.0	8.0	9.0	10.0	11.0	12.0	13.0	
139.4	135.9	132.5	129.0	122.1	115.1	108.2	101.3	94.3	87.4	124.3
152.7	148.9	145.2	141.4	133.9	126.3	118.8	111.2	103.7	96.2	135.4
166.0	162.0	157.9	153.8	145.6	137.5	129.3	121.2	113.0	104.8	147.3
179.6	175.2	170.8	166.5	157.7	148.9	140.2	131.4	122.6	113.9	158.5
193.0	188.3	183.6	178.9	169.5	160.2	150.8	141.4	132.0	122.6	170.4
206.7	201.7	196.7	191.7	181.8	171.8	161.8	151.8	141.9	131.9	182.3
220.3	215.0	209.7	204.4	193.8	183.2	172.6	162.0	151.4	140.8	194.2
233.3	227.7	222.2	216.6	205.4	194.3	183.1	172.0	160.8	149.7	205.4
247.1	241.2	235.3	229.4	217.7	205.9	194.2	182.4	170.6	158.9	217.3
261.2	255.0	248.8	242.7	230.3	218.0	205.6	193.3	180.9	168.6	229.2
275.0	268.5	262.0	255.5	242.6	229.6	216.7	203.7	190.7	177.8	241.1
289.3	282.6	275.8	269.0	255.5	242.0	228.5	214.9	201.4	187.9	253.7
303.4	296.3	289.2	282.1	268.0	253.9	239.7	225.6	211.4	197.3	265.6
317.5	310.1	302.8	295.4	280.6	265.9	251.2	236.4	221.7	206.9	277.5
332.0	324.4	316.7	309.0	293.7	278.4	263.1	247.8	232.5	217.2	290.2
346.3	338.3	330.4	322.4	306.5	290.5	274.6	258.7	242.8	226.8	302.8
359.9	351.6	343.4	335.1	318.7	302.2	285.7	269.2	252.7	236.2	314.0
374.3	365.7	357.2	348.6	331.5	314.4	297.3	280.2	263.1	246.0	326.7
388.8	379.9	371.1	362.2	344.5	326.9	309.2	291.5	273.8	256.1	338.6
403.7	394.6	385.5	376.3	358.1	339.8	321.6	303.3	285.1	266.8	351.2
418.5	409.0	399.6	390.2	371.3	352.5	333.7	314.8	296.0	277.1	363.9
433.2	423.5	413.7	404.0	384.6	365.1	345.6	326.2	306.7	287.3	376.5
448.1	438.0	428.0	418.0	397.9	377.9	357.9	337.8	317.8	297.7	389.2
463.3	453.0	442.7	432.4	411.8	391.2	370.6	350.0	329.4	308.8	401.8
478.3	467.7	457.1	446.5	425.3	404.0	382.8	361.6	340.4	319.2	414.5
493.5	482.6	471.7	460.8	439.0	417.2	395.4	373.6	351.8	330.0	427.9

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS

IN TONS OF 1000 KILOGRAMS

SQUARE ENDS



Allowable stress per square centimeter:
 925 kilograms for lengths under 52 radii.
 $1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.

Number of Section	Weight of Section, Kg. per Meter	Dimensions in Millimeters			Area of Section in Cm. ²	Least Radius of Gyration, Cm.	Unsupported Length of Columns, in Meters				
		D	T	B			3.0	3.5	4.0	4.5	5.0
H-12	96.0	299	16.1	303	122.6	7.57	113.4	113.4	112.9	109.7	106.6
	106.4	302	17.6	304	135.2	7.62	125.1	125.1	124.6	121.2	117.8
	116.1	305	19.1	305	148.0	7.65	136.9	136.9	136.6	132.8	129.1
	125.8	308	20.6	306	160.8	7.70	148.7	148.7	148.6	144.5	140.5
	136.2	311	22.1	307	173.7	7.72	160.7	160.7	160.6	156.2	151.9
	146.6	314	23.6	308	186.6	7.77	172.6	172.6	172.6	168.1	163.5
	156.3	318	25.6	309	199.6	7.80	184.6	184.6	184.6	180.0	175.0
	166.7	321	27.1	310	212.6	7.82	196.7	196.7	196.7	191.8	186.6
	176.4	324	28.6	311	225.0	7.87	208.1	208.1	208.1	203.3	197.8
	186.8	327	30.1	312	238.1	7.90	220.2	220.2	220.2	215.4	209.5
	197.2	330	31.6	313	251.4	7.95	232.5	232.5	232.5	227.8	221.6
	207.6	333	33.1	314	264.7	7.98	244.8	244.8	244.8	240.0	233.6
	218.0	337	35.1	315	278.1	8.00	257.2	257.2	257.2	252.3	245.6
	228.4	340	36.6	316	291.5	8.03	269.6	269.6	269.6	264.7	257.7
	239.6	343	38.1	317	305.0	8.08	282.1	282.1	282.1	277.4	270.1

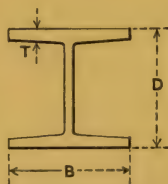
For detail dimensions, see page 62.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 12-INCH H-COLUMNS IN TONS OF 1000 KILOGRAMS SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

1125— $3.87 \frac{1}{r}$ for lengths over 52 radii.



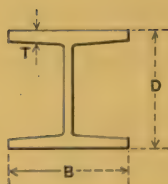
Unsupported Length of Columns, in Meters

										Weight of Section, Kilo- grams per Meter
5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0	11.0	
103.5	100.3	97.2	94.1	90.9	87.8	84.7	81.5	75.2	69.0	96.0
114.3	110.9	107.5	104.0	100.6	97.2	93.7	90.3	83.4	76.6	106.4
125.3	121.6	117.8	114.1	110.3	106.6	102.9	99.1	91.6	84.1	116.1
136.5	132.4	128.4	124.3	120.3	116.2	112.2	108.2	100.1	92.0	125.8
147.5	143.2	138.8	134.5	130.1	125.8	121.4	117.0	108.3	99.6	136.2
158.8	154.2	149.5	144.9	140.2	135.6	130.9	126.3	117.0	107.7	146.6
170.1	165.1	160.2	155.2	150.3	145.3	140.4	135.4	125.5	115.6	156.3
181.3	176.0	170.8	165.5	160.3	155.0	149.7	144.5	134.0	123.4	166.7
192.3	186.7	181.2	175.7	170.1	164.6	159.1	153.5	142.5	131.4	176.4
203.7	197.9	192.0	186.2	180.4	174.6	168.7	162.9	151.2	139.6	186.8
215.5	209.4	203.3	197.2	191.0	184.9	178.8	172.7	160.4	148.2	197.2
227.2	220.8	214.3	207.9	201.5	195.1	188.7	182.3	169.4	156.6	207.6
238.9	232.1	225.4	218.7	212.0	205.2	198.5	191.8	178.3	164.9	218.0
250.7	243.6	236.6	229.6	222.6	215.5	208.5	201.5	187.5	173.4	228.4
262.8	255.5	248.2	240.9	233.6	226.3	219.0	211.7	197.0	182.4	239.6

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS

IN TONS OF 1000 KILOGRAMS



SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.

Number of Section	Weight of Section, Kilograms per Meter	Dimensions in Millimeters			Area of Section in Square Centimeters	Least Radius of Gyration, Centimeters	Unsupported Length of Columns, in Meters			
		D	T	B			3.0	3.5	4.0	4.5
H-10	72.9	251	14.4	253	92.7	6.32	85.7	84.4	81.6	78.7
	80.4	254	15.9	254	102.6	6.38	94.9	93.6	90.5	87.4
	88.5	257	17.4	255	113.4	6.43	104.9	103.7	100.3	96.9
	97.5	260	18.9	256	124.1	6.45	114.8	113.6	109.8	106.1
	105.7	263	20.4	257	134.9	6.50	124.8	123.7	119.6	115.6
	114.6	267	22.4	258	145.7	6.53	134.8	133.7	129.4	125.1
	122.8	270	23.9	259	156.7	6.55	144.9	143.9	139.3	134.6
	131.7	273	25.4	260	167.7	6.60	155.1	154.2	149.3	144.4
	139.9	276	26.9	261	178.8	6.63	165.4	164.6	159.4	154.2
	148.1	279	28.4	262	189.2	6.65	175.0	174.3	168.8	163.3
	157.0	283	30.4	263	200.4	6.71	185.4	185.0	179.2	173.4
	165.9	286	31.9	264	211.6	6.73	195.7	195.5	189.4	183.3
	174.9	289	33.4	265	222.9	6.76	206.2	206.1	199.7	193.3
	183.8	292	34.9	266	234.3	6.78	216.7	216.7	210.1	203.4

For detail dimensions, see page 64.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 10-INCH H-COLUMNS

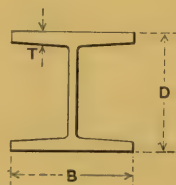
IN TONS OF 1000 KILOGRAMS

SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 25 radii.

1125— $3.87 \frac{l}{r}$ for lengths over 52 radii.



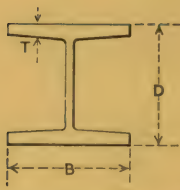
Unsupported Length of Columns, in Meters										Weight of Section, Kilograms per Meter
5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	
75.9	73.1	70.2	67.4	64.6	61.7	58.9	56.0	53.2	50.4	72.9
84.3	81.2	78.1	75.0	71.9	68.7	65.6	62.5	59.4	56.3	80.4
93.4	90.0	86.6	83.2	79.8	76.4	73.0	69.6	66.1	62.7	88.5
102.4	98.7	94.9	91.2	87.5	83.8	80.0	76.3	72.6	68.9	97.5
111.6	107.6	103.6	99.6	95.5	91.5	87.5	83.5	79.5	75.5	105.7
120.7	116.4	112.1	107.8	103.5	99.2	94.8	90.5	86.2	81.9	114.6
130.0	125.4	120.7	116.1	111.5	106.9	102.2	97.6	93.0	88.3	122.8
139.5	134.6	129.7	124.7	119.8	114.9	110.0	105.1	100.2	95.2	131.7
149.0	143.7	138.5	133.3	128.1	122.9	117.7	112.4	107.2	102.0	139.9
157.8	152.3	146.8	141.3	135.8	130.3	124.8	119.3	113.8	108.3	148.1
167.7	161.9	156.1	150.3	144.5	138.8	133.0	127.2	121.4	115.6	157.0
177.2	171.1	165.0	159.0	152.9	146.8	140.7	134.6	128.5	122.5	165.9
187.0	180.6	174.2	167.8	161.4	155.1	148.7	142.3	135.9	129.5	174.9
196.7	190.0	183.3	176.7	170.0	163.3	156.6	149.9	143.2	136.5	183.8

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS

IN TONS OF 1000 KILOGRAMS

SQUARE ENDS



Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{1}{r}$ for lengths over 52 radii.

Num- ber of Section	Weight of Section, Kilo- grams per Meter	Dimensions in Millimeters			Area of Section in Cm. ²	Least Radius of Gy- ration, Cm.	Unsupported Length of Columns, in Meters			
		D	T	B			2.5	3.0	3.5	4.0
H-8	47.6	200	11.2	203	59.2	5.03	54.8	52.9	50.7	48.4
	51.3	203	12.7	203	65.6	5.11	60.7	58.9	56.4	53.9
	58.0	206	14.2	204	74.2	5.16	68.6	66.8	64.0	61.2
	64.7	209	15.7	205	82.8	5.18	76.6	74.6	71.5	68.4
	71.4	213	17.7	206	91.5	5.21	84.6	82.5	79.1	75.8
	78.9	216	19.2	207	100.2	5.26	92.7	90.6	86.9	83.2
	85.6	219	20.7	208	109.0	5.28	100.8	98.7	94.7	90.7
	92.3	222	22.2	209	117.9	5.31	109.1	106.9	102.6	98.3
	99.7	225	23.7	210	126.8	5.36	117.3	115.2	110.6	106.0
	106.4	228	25.2	211	135.8	5.38	125.6	123.5	118.6	113.7
	113.8	232	27.2	212	144.9	5.41	131.0	131.9	126.7	121.6
	120.5	235	28.7	213	153.4	5.44	141.9	139.8	134.4	128.9
	127.2	238	30.2	214	162.6	5.49	150.4	148.5	142.8	137.1
	134.7	241	31.7	215	171.9	5.51	159.0	157.2	151.1	145.1

For detail dimensions, see page 66.

SAFE LOADS FOR BETHLEHEM ROLLED STEEL 8-INCH H-COLUMNS

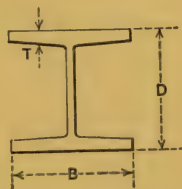
IN TONS OF 1000 KILOGRAMS

SQUARE ENDS

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125 - 3.87 \frac{l}{r}$ for lengths over 52 radii.



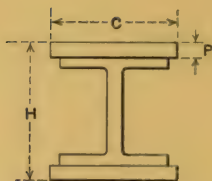
Unsupported Length of Columns, in Meters								Weight of Section, Kilo- grams per Meter
4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	
46.1	43.8	41.5	39.3	37.0	34.7	32.4		47.6
51.4	49.0	46.5	44.0	41.5	39.0	36.5		51.3
58.4	55.7	52.9	50.1	47.3	44.5	41.7		58.0
65.3	62.2	59.1	56.0	52.9	49.8	46.8		64.7
72.4	69.0	65.6	62.2	58.8	55.4	52.0		71.4
79.6	75.9	72.2	68.5	64.8	61.1	57.4		78.9
86.7	82.7	78.7	74.7	70.7	66.7	62.7		85.6
94.0	89.7	85.4	81.1	76.8	72.5	68.2		92.3
101.5	96.9	92.3	87.7	83.1	78.6	74.0	69.4	99.7
108.8	103.9	99.0	94.2	89.3	84.4	79.5	74.6	106.4
116.4	111.2	106.0	100.8	95.6	90.5	85.3	80.1	113.8
123.5	118.0	112.6	107.1	101.6	96.2	90.7	85.3	120.5
131.3	125.6	119.9	114.2	108.4	102.7	97.0	91.2	127.2
139.1	133.0	127.0	120.9	114.9	108.9	102.8	96.8	134.7

Loads to the right of the heavy line are for lengths greater than 125 radii.

SAFE LOADS FOR COMPOUND COLUMNS

IN TONS OF 1000 KILOGRAMS

SQUARE ENDS



H-14-b x 220.3 kilograms Special H-Column
Section reinforced with Cover Plates

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125-387\frac{1}{r}$ for lengths over 52 radii.

Number of Section	Weight of Section, Kilograms per Meter	Dimensions in Millimeters			Area of Section in Square Centimeters	Least Radius of Gyration, Centimeters	Unsupported Length of Columns, in Meters				
		C	P	H			3.0	3.5	4.0	4.5	5.0
Columns composed of a 356-millimeter x 220.3-kilogram Special Column Section, (H-14-b), reinforced with cover plates of width and thickness given in table.	422.6	406	31.6	422	538.8	10.11	498.4	498.4	498.4	498.4	498.4
	432.8	406	33.1	425	551.7	10.14	510.3	510.3	510.3	510.3	510.3
	442.9	406	35.1	429	564.6	10.19	522.3	522.3	522.3	522.3	522.3
	453.0	406	36.6	432	577.5	10.21	534.2	534.2	534.2	534.2	534.2
	463.1	406	38.1	435	590.5	10.26	546.2	546.2	546.2	546.2	546.2
	473.2	406	39.6	438	603.4	10.29	558.1	558.1	558.1	558.1	558.1
	483.4	406	41.1	441	616.3	10.31	570.1	570.1	570.1	570.1	570.1
	493.5	406	43.1	445	629.2	10.36	582.0	582.0	582.0	582.0	582.0
	503.6	406	44.6	448	642.1	10.39	593.9	593.9	593.9	593.9	593.9
	513.7	406	46.1	451	655.0	10.41	605.9	605.9	605.9	605.9	605.9
	521.3	432	44.6	448	664.6	10.92	614.8	614.8	614.8	614.8	614.8
	532.0	432	46.1	451	678.4	10.95	627.5	627.5	627.5	627.5	627.5
	542.7	432	47.6	454	692.1	10.97	640.2	640.2	640.2	640.2	640.2
	553.6	432	49.1	457	705.8	11.00	652.9	652.9	652.9	652.9	652.9
	564.3	432	50.6	460	719.5	11.05	665.5	665.5	665.5	665.5	665.5
	575.0	432	52.6	464	733.2	11.07	678.2	678.2	678.2	678.2	678.2
	585.8	432	54.1	467	746.9	11.10	690.9	690.9	690.9	690.9	690.9
	596.6	432	55.6	470	760.6	11.13	703.6	703.6	703.6	703.6	703.6
	607.3	432	57.1	473	774.3	11.15	716.2	716.2	716.2	716.2	716.2
	618.0	432	58.6	476	788.1	11.18	729.0	729.0	729.0	729.0	729.0
	630.1	457	57.1	473	803.4	11.73	743.1	743.1	743.1	743.1	743.1
	641.4	457	58.6	476	817.9	11.76	756.6	756.6	756.6	756.6	756.6
	652.9	457	60.1	479	832.4	11.79	770.0	770.0	770.0	770.0	770.0
	664.2	457	62.1	483	846.9	11.81	783.4	783.4	783.4	783.4	783.4
	675.6	457	63.6	486	861.4	11.84	796.8	796.8	796.8	796.8	796.8
	687.0	457	65.1	489	875.9	11.86	810.2	810.2	810.2	810.2	810.2
	698.4	457	66.6	492	890.4	11.89	823.6	823.6	823.6	823.6	823.6
	709.7	457	68.1	495	905.0	11.91	837.1	837.1	837.1	837.1	837.1
	721.2	457	69.6	498	919.5	11.94	850.5	850.5	850.5	850.5	850.5

For detail dimensions, see page 72.

SAFE LOADS FOR COMPOUND COLUMNS

IN TONS OF 1000 KILOGRAMS

SQUARE ENDS

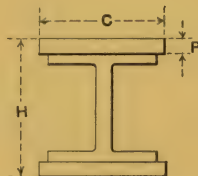
H-14-b x 220.3 kilograms Special H-Column

Section reinforced with Cover Plates

Allowable stress per square centimeter:

925 kilograms for lengths under 52 radii.

$1125-387\frac{1}{r}$ for lengths over 52 radii.



Unsupported Length of Columns, in Meters

Weight
of
Section,
Kilo-
grams
per
Meter

5.5	6.0	6.5	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	
492.7	482.4	472.1	461.8	441.2	420.5	399.9	379.3	358.7	338.0	317.4	422.6
504.9	494.3	483.8	473.3	452.2	431.2	410.1	389.0	368.0	346.9	325.9	432.8
517.2	506.5	495.8	485.1	463.6	442.2	420.8	399.3	377.9	356.4	335.0	442.9
529.3	518.4	507.4	496.5	474.6	452.7	430.8	408.9	387.0	365.1	343.2	453.0
541.8	530.7	519.5	508.4	486.1	463.9	441.6	419.3	397.0	374.8	352.5	463.1
554.0	542.7	531.3	520.0	497.3	474.6	451.9	429.2	406.5	383.8	361.1	473.2
566.1	554.5	543.0	531.4	508.3	485.1	462.0	438.9	415.7	392.6	369.5	483.4
578.6	566.8	555.1	543.3	519.8	496.3	472.8	449.3	425.8	402.3	378.8	493.5
590.8	578.9	566.9	554.9	531.0	507.1	483.2	459.3	435.4	411.5	387.5	503.6
602.9	590.8	578.6	566.4	542.1	517.7	493.4	469.0	444.7	420.3	396.0	513.7
614.8	606.4	594.6	582.8	559.2	535.7	512.1	488.6	465.0	441.5	417.9	521.3
627.5	619.3	607.4	595.4	571.4	547.4	523.4	499.5	475.5	451.5	427.5	532.0
640.2	632.1	619.9	607.7	583.3	558.9	534.5	510.0	485.6	461.2	436.8	542.7
652.9	645.0	632.6	620.2	595.4	570.5	545.7	520.9	496.1	471.2	446.4	553.6
665.5	658.2	645.7	633.0	607.8	582.7	557.4	532.3	507.1	481.9	456.7	564.3
678.2	671.1	658.2	645.4	619.8	594.2	568.5	542.9	517.3	491.6	466.0	575.0
690.9	684.0	671.0	658.0	631.9	605.9	579.9	553.8	527.8	501.7	475.7	585.8
703.6	697.0	683.8	670.6	644.1	617.7	591.2	564.8	538.3	511.9	485.4	596.6
716.2	709.8	696.4	683.0	656.1	629.2	602.3	575.5	548.6	521.7	494.8	607.3
729.0	722.9	709.3	695.6	668.4	641.1	613.8	586.5	559.3	532.0	504.7	618.0
743.1	743.1	731.5	718.3	691.8	665.3	638.8	612.3	585.8	559.2	532.7	630.1
756.6	756.6	745.2	731.7	704.8	677.9	651.0	624.1	597.1	570.2	543.3	641.4
770.0	770.0	758.8	745.2	717.9	690.5	663.2	635.9	608.6	581.2	553.9	652.9
783.4	783.4	772.4	758.5	730.7	703.0	675.2	647.5	619.7	592.0	564.2	664.2
796.8	796.8	786.1	772.0	743.8	715.7	687.5	659.4	631.2	603.1	574.9	675.6
810.2	810.2	799.6	785.3	756.7	728.2	699.6	671.0	642.4	613.8	585.3	687.0
823.6	823.6	813.3	798.8	769.8	740.9	711.9	682.9	653.9	624.9	596.0	698.4
837.1	837.1	827.0	812.3	782.9	753.5	724.1	694.7	665.2	635.8	606.4	709.7
850.5	850.5	840.7	825.8	796.0	766.2	736.4	706.6	676.8	647.0	617.2	721.2

Loads to the right of the heavy line are for lengths greater than 125 radii.

MAXIMUM SAFE SHEAR
ON THE
WEBS OF BEAMS AND GIRDERS

BETHLEHEM I-BEAMS AND
GIRDER BEAMS
FOR RAILROAD BRIDGES

NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

Metric tables are printed on colored paper for convenience of reference.

MAXIMUM SAFE SHEAR ON THE WEBS OF BEAMS AND GIRDERS

On relatively short spans the safe strength of the web of the beam against, crippling, caused by the shearing stress, may determine the maximum safe load which the beam should support.

The shearing stresses in the web of a beam may be resolved into two component stresses of equal intensity, at right angles to each other, and at angles of 45 degrees with the neutral axis. Both of these stresses are of the same intensity and equal to that of the vertical shear. These component stresses are equivalent to compressive and tensile forces acting upon the web of the beam. The compressive forces tend to buckle the web, but it is not entirely free to buckle because the tensile forces acting at right angles have the effect of stiffening it.

The formula in general use for determining the maximum safe shear on the webs of beams and girders is as follows:

$$\text{Maximum safe shear in pounds} = \frac{12,000 \text{ } d t}{1 + \frac{h^2}{3000 t^2}}$$

where d = depth of beam, t = thickness of web, and h = clear distance between flanges, all dimensions in inches.

The safe shears on the webs of Bethlehem Beams and Girders, derived from this formula, are given in the tables on pages 128 and 129, and also the corresponding minimum spans for the greatest safe uniformly distributed loads.

The safe uniformly distributed load for any span less than the minimum span given must not exceed twice the safe shear. The safe load concentrated at the center of a span must not be greater than twice the safe shear given, and the corresponding minimum span will be one-half the minimum span given in the table. Loading of any kind must not produce a shear exceeding the safe shear given unless the webs are stiffened.

In general, the shearing strength of the webs will be found ample for all ordinary cases of loading.

MAXIMUM SAFE SHEAR FOR BETHLEHEM I-BEAMS AND GIRDER BEAMS

Based upon the Crippling Strength of the Webs—also the
Corresponding Minimum Spans for Greatest Safe
Uniformly Distributed Loads

I-Beams					Girder Beams				
Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Maximum Safe Shear, Pounds	Minimum Span, Feet	Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Maximum Safe Shear, Pounds	Minimum Span, Feet
B-30	30	120.0	103,800	17.9	G-30-a	30	200.0	189,300	17.2
B-28	28	105.0	89,000	17.2	G-30	30	180.0	165,200	17.6
B-26	26	90.0	75,300	16.2	G-28	28	165.0	150,300	16.6
B-24-a	24	84.0	75,100	14.1	G-26-a	26	160.0	135,900	17.0
B-24	24	83.0	93,100	10.7	G-26	26	150.0	135,900	15.6
	24	73.0	54,000	17.2	G-24-a	24	140.0	121,700	15.3
B-20-a	20	82.0	102,400	8.1	G-24	24	120.0	98,500	16.3
	20	72.0	64,900	12.1	G-20-a	20	140.0	124,200	12.6
B-20	20	69.0	88,200	7.7	G-20	20	112.0	98,500	12.7
	20	64.0	69,400	9.4	G-18	18	92.0	76,100	12.4
	20	59.0	50,000	12.5	G-15-b	15	140.0	134,200	8.4
	18	59.0	78,000	6.7	G-15-a	15	104.0	94,300	9.2
B-18	18	54.0	57,500	8.7	G-15	15	73.0	59,200	10.6
	18	52.0	49,200	9.9	G-12-a	12	70.0	57,200	8.4
	18	48.5	36,700	12.9	G-12	12	55.0	42,300	9.1
B-15-b	15	71.0	77,900	7.3	G-10	10	44.0	29,800	8.7
	15	64.0	93,900	5.0	G-9	9	38.0	26,700	7.6
B-15-a	15	54.0	54,800	7.9	G-8	8	32.5	23,600	6.5
B-15	15	46.0	60,000	5.7	$\text{Maximum Safe Shear} = \frac{12,000 \text{ dt}}{1 + \frac{h^2}{3,000t^2}}$				
	15	41.0	39,900	8.1					
	15	38.0	30,100	10.5	Where				
B-12-a	12	36.0	32,200	7.4	d = depth of beam,				
	12	32.0	35,800	5.7	t = thickness of web,				
B-12	12	28.5	22,200	8.7	h = clear distance between flanges.				
	10	28.5	39,800	3.6	All dimensions in inches.				
B-10	10	23.5	21,000	6.2					
	10	23.5	21,000	6.2					

MAXIMUM SAFE SHEAR FOR BETHLEHEM I-BEAMS AND GIRDER BEAMS

Based Upon the Crippling Strength of the Webs—also the
Corresponding Minimum Spans for Greatest Safe
Uniformly Distributed Loads

I-Beams					Girder Beams				
Number of Section	Depth of Beam	Weight per Meter	Maximum Safe Shear	Minimum Span	Number of Section	Depth of Beam	Weight per Meter	Maximum Safe Shear	Minimum Span
	Mm.	Kg	Kg.	Meters		Mm.	Kg.	Kg.	Meters
B-30	762	178.6	48,830	5.6	G-30-a	762	297.6	89,050	5.4
B-28	711	156.3	41,870	5.4	G-30	762	267.9	77,720	5.5
B-26	660	133.9	35,420	5.1	G-28	711	245.6	70,710	5.2
B-24-a	610	125.0	35,330	4.4	G-26a	660	238.1	63,930	5.3
B-24	610	123.5	43,800	3.4	G-26	660	223.2	63,930	4.9
	610	108.6	25,400	5.4	G-24-a	610	208.3	57,250	4.8
B-20-a	508	122.0	48,170	2.5	G-24	610	178.6	46,340	5.1
	508	107.2	30,530	3.8	G-20-a	508	208.3	58,430	4.0
	508	102.7	41,490	2.4	G-20	508	166.7	46,340	4.0
B-20	508	95.2	32,650	2.9	G-18	457	136.9	35,800	3.9
	508	87.8	23,520	3.9	G-15-b	381	208.3	63,130	2.6
	457	87.8	36,690	2.1	G-15-a	381	154.8	44,360	2.9
B-18	457	80.4	27,050	2.7	G-15	381	108.6	27,850	3.3
	457	77.4	23,150	3.1	G-12-a	305	104.2	26,910	2.6
	457	72.2	17,260	4.0	G-12	305	81.9	19,900	2.8
B-15-b	381	105.7	36,650	2.3	G-10	254	65.5	14,020	2.7
B-15-a	381	95.2	44,170	1.6	G-9	229	56.6	12,560	2.4
	381	80.4	25,780	2.5	G-8	203	48.4	11,100	2.0
	381	68.5	28,230	1.8	$\left. \begin{array}{l} \text{Maximum Safe Shear} \\ \text{in Kilograms} \end{array} \right\} = \frac{8.75dt}{h^2} \cdot \frac{1}{1 + 3000t^2}$				
B-15	381	61.0	18,770	2.6					
	381	56.6	14,160	3.3	Where d=depth of beam, t=thickness of web, h=clear distance between flanges. All dimensions in millimeters.				
B-12-a	305	53.6	15,150	2.3					
B-12	305	47.6	16,840	1.8					
	305	42.4	10,440	2.7					
B-10	254	42.4	18,720	1.1					
	254	35.0	9,880	2.0					

BETHLEHEM I-BEAMS AND GIRDER BEAMS FOR RAILROAD BRIDGES

The table on the opposite page shows the application of Bethlehem Rolled Beam and Girder Sections for use as track stringers in railroad bridges and for short span railroad bridges. The table is calculated according to Theodore Cooper's Specifications for Railroad Bridges for a loading of E-40, equivalent to a capacity for 142-ton locomotives. All figures are given for one rail or one-half track.

The size and weight of the Bethlehem Rolled Sections which are required for the purpose are given for the various spans. As a comparison, the size and weight of the corresponding present Standard I-Beams that could be employed for the same purpose are also given, so far as Standard Beams could be used. The economical weight of the Bethlehem Beams is apparent from this comparison. Riveted girders would be required on spans greater than 17 feet in length, unless the more economical rolled Bethlehem Beams are used.

Bethlehem Rolled Beams, for all spans under 25 feet in length, will weigh less than the most economical riveted girder it is possible to design, even when the depth of the latter is unlimited. For spans over 25 feet in length the rolled beams will weigh less than riveted girders of equal depth.

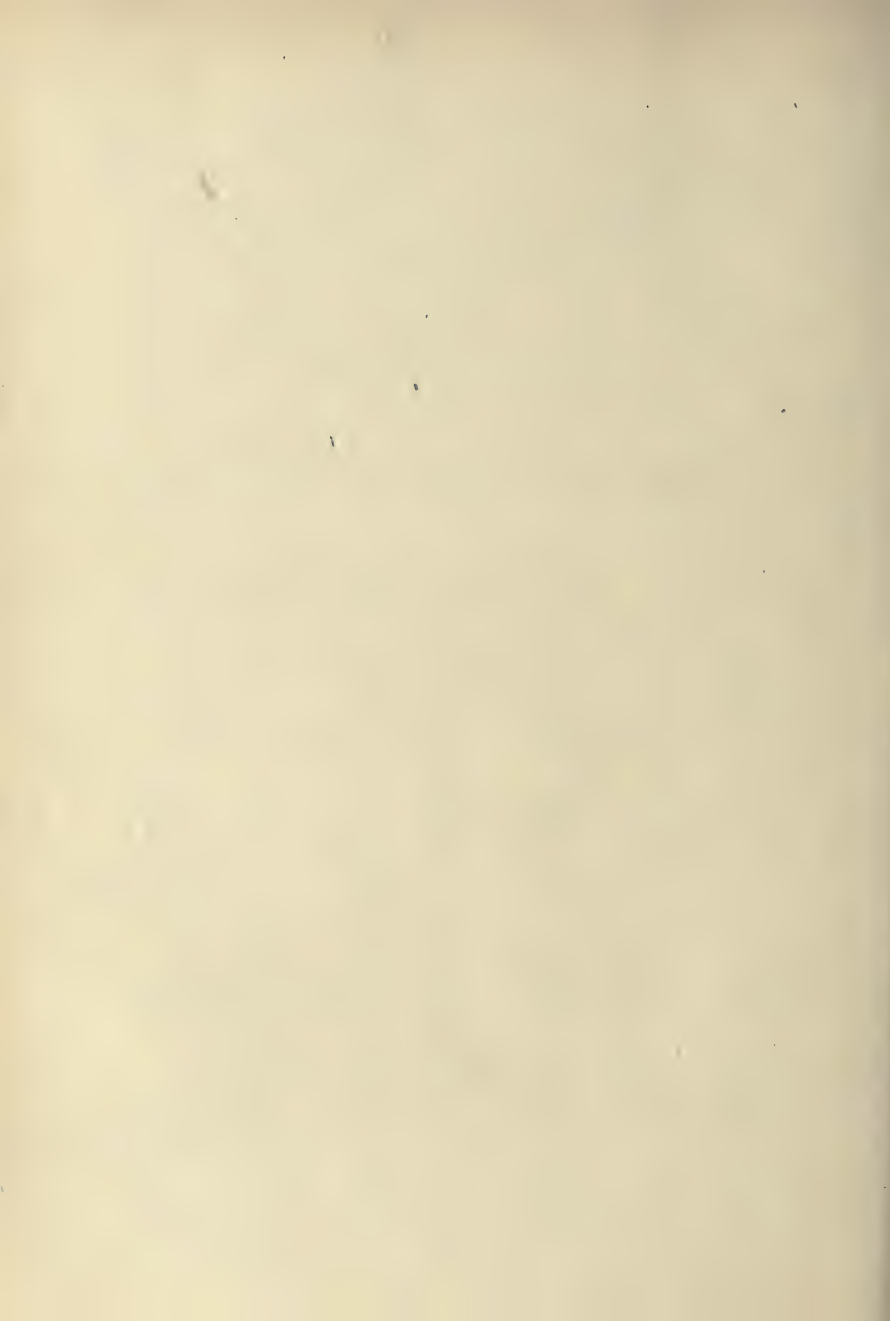
In every case the Bethlehem Rolled Section is economical, weight or cost considered, as compared with a Standard I-Beam or with a riveted girder.

The Bethlehem Beams also can be used to advantage for the cross girders or floor beams of bridges. Where available depth is limited, the rolled girder sections having twice the section modulus of standard beams of equal depth will be found desirable for stringers or cross girders and prove economical in weight and cost as compared with built-up riveted girders which otherwise would be required. These rolled girder sections will also be found specially adapted for solid bridge floors of shallow depth.

BETHLEHEM I-BEAMS AND GIRDER BEAMS USED FOR RAILROAD TRACK STRINGERS AND SHORT SPAN RAILROAD BRIDGES

DESIGNED ACCORDING TO COOPER'S SPECIFICATIONS FOR LOADING E-40

Span, in Feet	Bending Moment, in Foot- pounds for $\frac{1}{2}$ Track	Section Modulus Required	Bethlehem Rolled Sections Required			Most Economical Standard I-Beam that Could be Used	
			Section Number	Depth, Inches	Weight per Foot, Pounds	Weight per Foot, Pounds	Size
10	65,800	79	B-15-a	15	54.0	60	15" I
11	76,700	92	B-18	18	52.0	60	18" I
12	89,000	107	B-20	20	59.0	65	20" I
13	102,000	122	B-20	20	64.0	70	20" I
14	116,800	140	B-20-a	20	72.0	80	20" I
15	133,000	160	B-24	24	73.0	80	24" I
16	149,000	179	B-24	24	83.0	85	24" I
17	166,000	199	B-24-a	24	84.0	100	24" I
18	182,000	218	B-26	26	90.0	Bethlehem Rolled Sections, for spans under 25 feet, weigh less than the most economical riveted girder possible to design with unlimited depth. Bethlehem Rolled Sections, for spans over 25 feet, weigh less than riveted girders of nearly equal depth.	
19	200,600	241	B-28	28	105.0		
20	223,000	268	B-28	28	105.0		
21	243,000	292	B-30	30	120.0		
22	266,000	320	B-30	30	120.0		
23	287,000	344	B-30	30	120.0		
24	310,000	372	G-26	26	150.0		
25	331,000	397	G-26	26	150.0		
26	354,000	425	G-26-a	26	160.0		
27	377,000	452	G-28	28	165.0		
28	401,000	481	G-30	30	180.0		
29	427,000	512	G-30	30	180.0		
30	453,000	544	G-30	30	180.0		
31	478,000	575	G-30-a	30	200.0		
32	504,000	605	G-30-a	30	200.0		

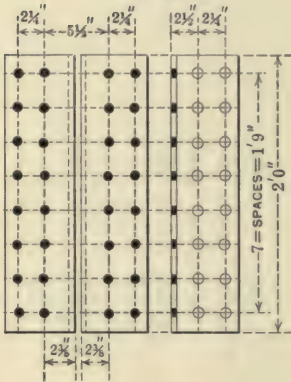


CONNECTION ANGLES
FOR
BETHLEHEM ROLLED GIRDER
AND I-BEAMS

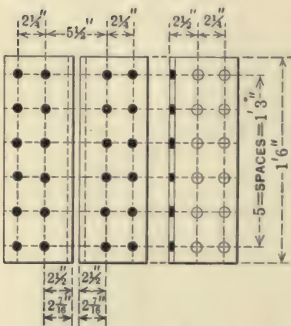
NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

Metric tables are printed on colored paper for convenience of reference.

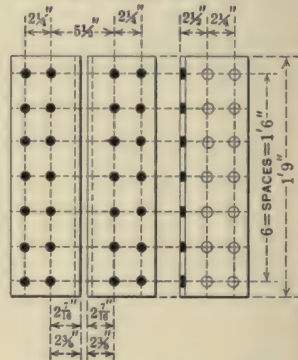
CONNECTION ANGLES FOR BETHEHEM ROLLED GIRDER BEAMS

30" G

2 Legs 6" x 6" x $\frac{7}{16}$ " x 2' 0"
Weight 77 pounds

24" G

2 Legs 6" x 6" x $\frac{7}{16}$ " x 1' 6"
Weight 57 pounds

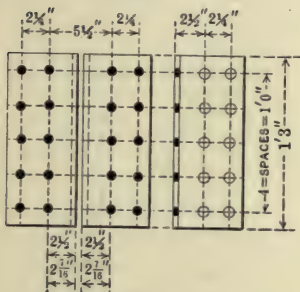
26" and 28" G

2 Legs 6" x 6" x $\frac{7}{16}$ " x 1' 9"
Weight 67 pounds

All holes $\frac{13}{16}$ " diameter for $\frac{3}{4}$ " diameter rivets.

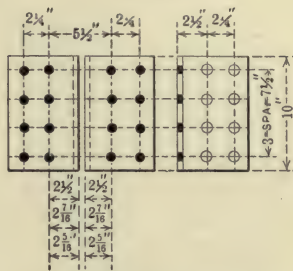
CONNECTION ANGLES FOR BETHLEHEM ROLLED GIRDER BEAMS

20" G



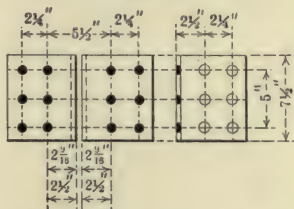
2 Legs 6" x 6" x $\frac{7}{16}$ " x 1' 3"
Weight 48 pounds

15" G



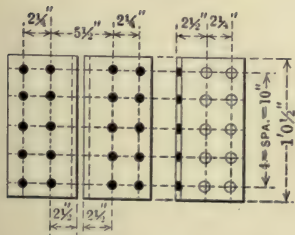
2 Legs 6" x 6" x $\frac{7}{16}$ " x 1' 0"
Weight 48 pounds

10" and 12" G



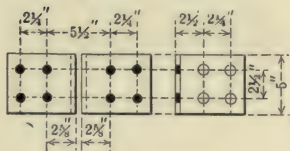
2 Legs 6" x 6" x $\frac{7}{16}$ " x 7 1/2"
Weight 32 pounds

18" G



2 Legs 6" x 6" x $\frac{7}{16}$ " x 1' 0 1/2"
Weight 41 pounds

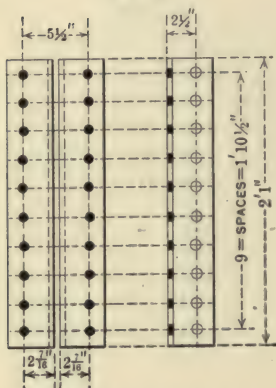
8" and 9" G



2 Legs 6" x 6" x $\frac{3}{8}$ " x 5"
Weight 17 pounds

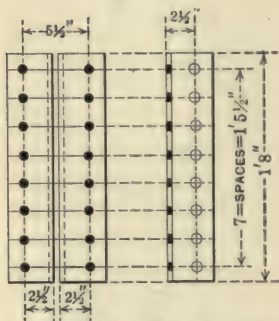
CONNECTION ANGLES FOR BETHLEHEM I-BEAMS

30" I



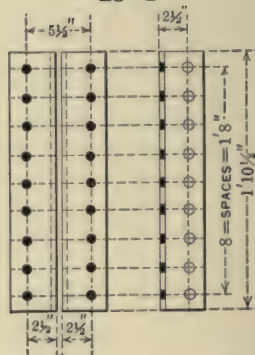
2 Legs 4" x 4" x $\frac{3}{8}$ " x 2' 1"
Weight 46 pounds

26" I



2 Legs 4" x 4" x $\frac{3}{8}$ " x 1' 8"
Weight 37 pounds

28" I

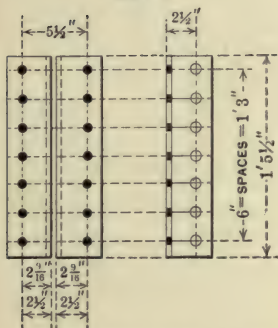


2 Legs 4" x 4" x $\frac{3}{8}$ " x 1' 10 1/2"
Weight 41 pounds

All holes for $\frac{13}{16}$ " diameter for $\frac{3}{4}$ " diameter rivets.

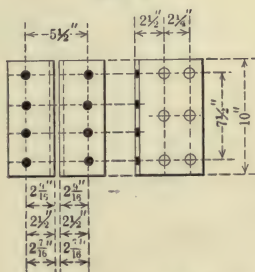
CONNECTION ANGLES FOR BETHLEHEM I-BEAMS

24" I



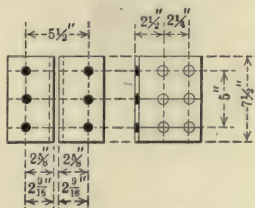
2 Legs 4" x 4" x 3/8" x 1' 5 1/2"
Weight 32 pounds

15" I



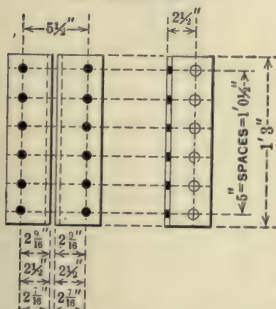
2 Legs 6" x 4" x 3/8" x 10"
Weight 24 pounds

12" I



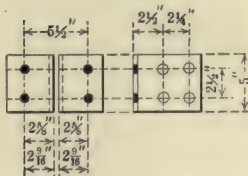
2 Legs 6" x 4" x 3/8" x 7 1/2"
Weight 18 pounds

18" and 20" I



2 Legs 4" x 4" x 3/8" x 1' 3"
Weight 28 pounds

10" I



2 Legs 6" x 4" x 3/8" x 5"
Weight 12 pounds

MINIMUM SPANS, IN FEET, ON WHICH THE CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS

Depth of Beam, Inches	Weight per Foot, Pounds	Least Span, in Feet, for Various Conditions								Field Connection Rivet Shear, 8,000 Pounds per Square Inch
		Rivets: Shearing 10,000 Pounds, Bearing 20,000 Pounds per Square Inch								
		Connection to Web of Beam	Field Connection	When two beams frame opposite each other to a beam or girder with a web thickness as follows:						
				$\frac{9}{16}$ Inch	$\frac{1}{2}$ Inch	$\frac{7}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{5}{16}$ Inch	$\frac{1}{4}$ Inch	
30	200.0	23.0	23.0	24.1	27.1	31.0	36.2	43.4	54.2	28.8
30	180.0	20.6	20.6	21.6	24.3	27.7	32.4	38.8	48.6	25.8
28	180.0	22.4	22.4	23.4	26.4	30.1	35.1	42.2	52.7	28.0
28	165.0	20.2	20.2	21.2	23.8	27.2	31.7	38.1	47.6	25.3
26	160.0	18.6	18.6	19.5	22.0	25.1	29.3	35.1	43.9	23.3
26	150.0	17.1	17.1	17.9	20.1	23.0	26.8	32.2	40.3	21.4
24	140.0	17.6	17.6	18.4	20.7	23.7	27.7	33.2	41.5	22.0
24	120.0	16.8	15.1	15.8	17.8	20.4	23.8	28.5	35.6	18.9
20	140.0	17.7	17.7	18.5	20.9	23.8	27.8	33.4	41.7	22.1
20	112.0	15.1	14.1	14.8	16.7	19.0	22.2	26.6	33.3	17.7
18	92.0	13.1	10.7	11.2	12.6	14.4	16.8	20.1	25.1	13.3
15	140.0	16.0	16.0	16.8	18.9	21.6	25.2	30.2	37.8	20.0
15	104.0	12.3	12.3	12.9	14.5	16.5	19.3	23.1	28.9	15.3
15	73.0	12.2	8.9	9.3	10.5	12.0	14.0	16.8	20.9	11.1
12	70.0	11.6	9.0	9.5	10.6	12.2	14.2	17.0	21.3	11.3
12	55.0	11.5	7.2	7.6	8.5	9.8	11.4	13.7	17.1	9.1
10	44.0	9.3	4.9	5.1	5.8	6.6	7.7	9.3	11.6	6.1
9	38.0	11.3	5.7	6.0	6.8	7.7	9.0	10.8	13.5	7.2
8	32.5	8.8	4.3	4.5	5.1	5.8	6.8	8.1	10.2	5.4

The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

Weights of Connection Angles for Girder Beams

Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection
30 Inches	77 Pounds	20 Inches	48 Pounds	10 Inches	25 Pounds
28 "	67 "	18 "	41 "	9 "	17 "
26 "	67 "	15 "	32 "	8 "	17 "
24 "	57 "	12 "	25 "		

Weights do not include rivets for field connections.

MINIMUM SPANS, IN FEET, ON WHICH THE CONNECTION ANGLES FOR BETHLEHEM I-BEAMS CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS

Depth of Beam, Inches	Weight per Foot, Pounds	Least Span, in Feet, for Various Conditions									Field Connection. Rivet Shear, 8,000 Pounds per Square Inch
		Rivets: Shearing 10,000 Pounds, Bearing 20,000 Pounds per Square Inch									
		Connection to Web of Beam	Field Connection	When two beams frame opposite each other to a beam or girder with a web thickness as follows:							
				$\frac{9}{16}$ Inch	$\frac{1}{2}$ Inch	$\frac{7}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{5}{16}$ Inch	$\frac{1}{4}$ Inch		
30	120.0	23.0	21.1	22.1	24.8	28.4	33.1	39.7	49.7	26.3	
28	105.0	22.7	19.2	20.1	22.7	25.9	30.2	36.2	45.3	24.0	
26	90.0	22.1	17.3	18.1	20.4	23.3	27.1	32.6	40.7	21.6	
24	84.0	21.9	17.1	17.9	20.2	23.1	26.9	32.2	40.3	21.4	
24	73.0	22.7	15.0	15.7	17.7	20.2	23.6	28.3	35.4	18.8	
20	72.0	20.2	14.7	15.4	17.4	19.9	23.2	27.8	34.8	18.4	
20	59.0	18.5	11.8	12.3	13.9	15.9	18.5	22.2	27.8	14.7	
18	48.5	16.4	8.9	9.3	10.5	12.0	14.0	16.8	21.0	11.2	
15	71.0	12.1	16.0	16.8	18.9	21.6	25.1	30.2	37.7	20.0	
15	54.0	11.8	12.3	12.8	14.5	16.5	19.3	23.1	28.9	15.3	
15	38.0	12.1	8.9	9.3	10.5	12.0	14.0	16.8	21.0	11.1	
12	36.0	8.6	9.0	9.5	10.6	12.2	14.2	17.0	21.3	11.3	
12	28.5	8.5	7.2	7.6	8.5	9.8	11.4	13.7	17.1	9.1	
10	23.5	8.7	7.4	7.8	8.7	10.0	11.6	14.0	17.5	9.3	
9	20.0	6.7	5.7	6.0	6.7	7.7	9.0	10.8	13.5	7.1	
8	17.5	5.1	4.3	4.5	5.1	5.8	6.8	8.2	10.2	5.4	
The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.											

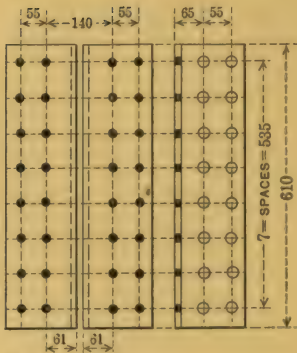
Weights of Connection Angles for Bethlehem I-Beams

Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection
30 Inches	46 Pounds	20 Inches	28 Pounds	10 Inches	12 Pounds
28 "	41 "	18 "	28 "	9 "	12 "
26 "	37 "	15 "	24 "	8 "	12 "
24 "	32 "	12 "	18 "		

Weights do not include rivets for field connections.

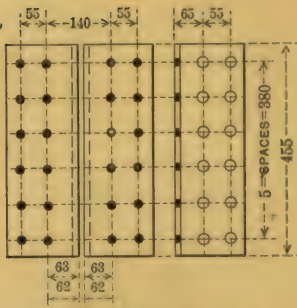
CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

30" G



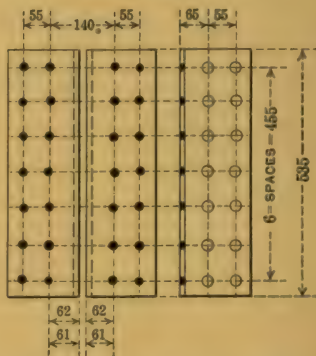
2 Legs 150 x 150 x 11 x 610
Weight 34.9 kilograms

24" G



2 Legs 150 x 150 x 11 x 455
Weight 25.9 kilograms

26" and 28" G

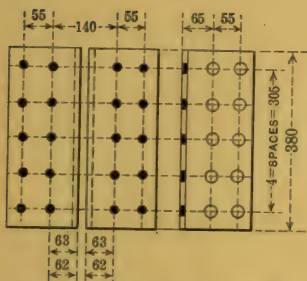


2 Legs 150 x 150 x 11 x 535
Weight 30.4 kilograms

All holes 20 millimeters diameter for 19 millimeter diameter rivets or bolts.
All dimensions are in millimeters.

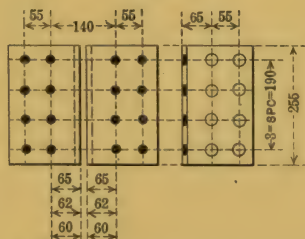
CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

20" G



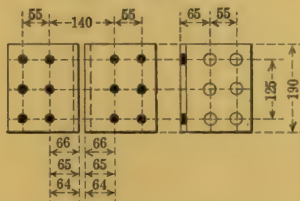
2 Legs 150 x 150 x 11 x 380
Weight 21.8 kilograms

15" G



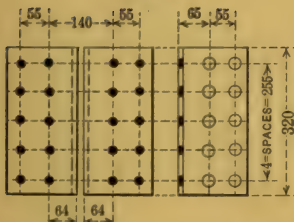
2 Legs 150 x 150 x 11 x 255
Weight 14.5 kilograms

10" and 12" G



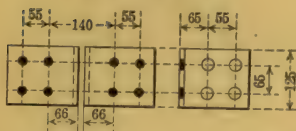
2 Legs 150 x 150 x 11 x 190
Weight 11.3 kilograms

18" G



2 Legs 150 x 150 x 11 x 320
Weight 18.6 kilograms

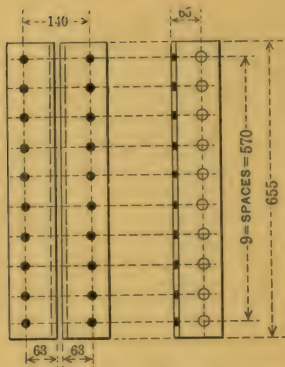
8" and 9" G



2 Legs 150 x 150 x 10 x 125
Weight 7.7 kilograms

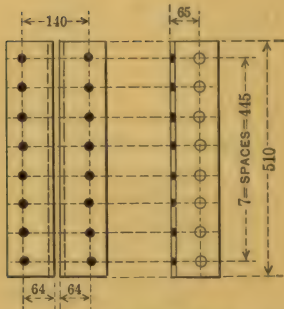
CONNECTION ANGLES FOR BETHLEHEM I-BEAMS

30" I



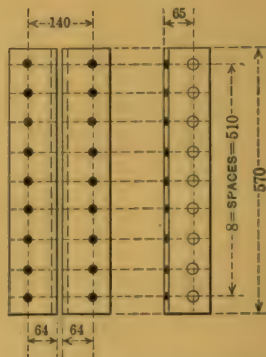
2 Legs 100 x 100 x 10 x 655
Weight 20.9 kilograms

26" I



2 Legs 100 x 100 x 10 x 510
Weight 16.8 kilograms

28" I



2 Legs 100 x 100 x 10 x 570
Weight 18.6 kilograms

All holes 20 millimeters diameter for 19 millimeters diameter rivets or bolts.
All dimensions are in millimeters.

MINIMUM SPANS, IN METERS, ON WHICH THE CONNECTION ANGLES FOR BETHLEHEM ROLLED GIRDER BEAMS CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS

Depth of Beam, Millimeters	Weight per Meter, Kilograms	Least Span, in Meters, for Various Conditions								Field Connection Rivet Shear, 600 Kilograms per Square Centimeter
		Rivets: Shearing 750 Kilograms, Bearing 1500 Kilograms, per Square Centimeter								
		Con- nection to Web of Beam	Field Con- nection	When two beams frame opposite to each other to a beam or girder with a web thickness as follows:						
				$\frac{9}{16}$ Inch	$\frac{1}{2}$ Inch	$\frac{7}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{5}{16}$ Inch	$\frac{3}{4}$ Inch	
				14.3 Mm.	12.7 Mm.	11.1 Mm.	9.5 Mm.	7.9 Mm.	6.4 Mm.	
762	297.6	7.0	7.0	7.3	8.3	9.4	11.0	13.2	16.5	8.8
762	267.9	6.3	6.3	6.6	7.4	8.4	9.9	11.8	14.8	7.9*
711	245.6	6.2	6.2	6.5	7.3	8.3	9.7	11.6	14.5	7.7
660	238.1	5.7	5.7	5.9	6.7	7.7	8.9	10.7	13.4	7.1
660	223.2	5.2	5.2	5.5	6.1	7.0	8.2	9.8	12.3	6.5
610	208.3	5.4	5.4	5.6	6.3	7.2	8.4	10.1	12.6	6.7
610	178.6	5.1	4.6	4.8	5.4	6.2	7.3	8.7	10.9	5.8
508	208.3	5.4	5.4	5.6	6.4	7.3	8.5	10.2	12.7	6.7
508	166.7	4.6	4.3	4.5	5.1	5.8	6.8	8.1	10.1	5.4
457	136.9	4.0	3.3	3.4	3.8	4.4	5.1	6.1	7.7	4.1
381	208.3	4.9	4.9	5.1	5.8	6.6	7.7	9.2	11.5	6.1
381	154.8	3.7	3.7	3.9	4.4	5.0	5.9	7.0	8.8	4.7
381	108.6	3.7	2.7	2.8	3.2	3.7	4.3	5.1	6.4	3.4
305	104.2	3.5	2.7	2.9	3.2	3.7	4.3	5.2	6.5	3.4
305	81.9	3.5	2.2	2.3	2.6	3.0	3.5	4.2	5.2	2.8
254	65.5	2.8	1.5	1.6	1.8	2.0	2.3	2.8	3.5	1.9
229	56.6	3.4	1.7	1.8	2.1	2.3	2.7	3.3	4.1	2.2
203	48.4	2.7	1.3	1.4	1.6	1.8	2.1	2.5	3.1	1.6

The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

Weights of Connection Angles for Rolled Girder Beams

Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection
Millimeters	Kilograms	Millimeters	Kilograms	Millimeters	Kilograms
762	34.9	508	21.8	254	11.3
711	30.4	457	18.6	229	7.7
660	30.4	381	14.5	203	7.7
610	25.9	305	11.3		

Weights do not include rivets for field connections.

MINIMUM SPANS, IN METERS, ON WHICH THE CONNECTION ANGLES FOR BETHLEHEM I-BEAMS CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS

Depth of Beam, Millimeters	Weight per Meter, Kilograms	Least Span, in Meters, for Various Conditions								
		Rivets: Shearing 750 Kilograms, Bearing 1500 Kilograms, per Square Centimeter								Field Connection
		Con- nection to Web of Beam	Field Con- nec- tion	When two beams frame opposite to each other to a beam or girder with a web thickness as follows:						Rivet Shear, 600 Kilograms per Square Cen- ti- meter
				$\frac{9}{16}$ Inch	$\frac{1}{2}$ Inch	$\frac{7}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{5}{16}$ Inch	$\frac{1}{4}$ Inch	
				14.3 Mm.	12.7 Mm.	11.1 Mm.	9.5 Mm.	7.9 Mm.	6.4 Mm.	
762	178.6	7.0	6.4	6.7	7.6	8.7	10.1	12.1	15.1	8.0
711	156.3	6.9	5.9	6.1	6.9	7.9	9.2	11.0	13.8	7.3
660	133.9	6.7	5.3	5.5	6.2	7.1	8.3	9.9	12.4	6.6
610	125.0	6.7	5.2	5.5	6.2	7.0	8.2	9.8	12.3	6.5
610	108.6	6.9	4.6	4.8	5.4	6.2	7.2	8.6	10.8	5.7
508	107.2	6.2	4.5	4.7	5.3	6.1	7.1	8.5	10.6	5.6
508	87.8	5.6	3.6	3.7	4.2	4.8	5.6	6.8	8.5	4.5
457	72.2	5.0	2.7	2.8	3.2	3.7	4.3	5.1	6.4	3.4
381	105.7	3.7	4.9	5.1	5.8	6.6	7.7	9.2	11.5	6.1
381	80.4	3.6	3.7	3.9	4.4	5.0	5.9	7.0	8.8	4.7
381	56.6	3.7	2.7	2.8	3.2	3.7	4.3	5.1	6.4	3.4
305	53.6	2.6	2.7	2.9	3.2	3.7	4.3	5.2	6.5	3.4
305	42.4	2.6	2.2	2.3	2.6	3.0	3.5	4.2	5.2	2.8
254	35.0	2.7	2.3	2.4	2.7	3.0	3.5	4.3	5.3	2.8

The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

Weights of Connecting Angles for Bethlehem I-Beams

Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection	Depth of Beam	Weight of One Connection
Millimeters	Kilograms	Millimeters	Kilograms	Millimeters	Kilograms
762	20.9	610	14.5	381	10.9
711	18.6	508	12.7	305	8.2
660	16.8	457	12.7	254	5.4

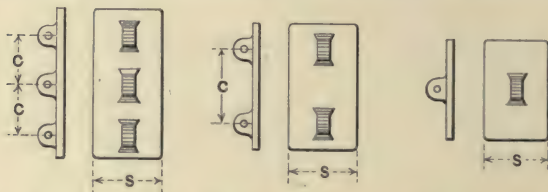
Weights do not include rivets for field connections.

CAST IRON SEPARATORS
FOR
BETHLEHEM ROLLED GIRDER
AND I-BEAMS

NOTE.—Tables in both the English System and the Metric System will be found in each section of this Bulletin.

Metric tables are printed on colored paper for convenience of reference.

CAST IRON SEPARATORS FOR BETHLEHEM GIRDER BEAMS



Separators for 18 to 30-inch beams are $\frac{5}{8}$ -inch metal.
Separators for 8 to 15-inch beams are $\frac{1}{2}$ -inch metal.

SEPARATORS WITH THREE BOLTS

Designation of Beam			Distances			Bolts		Weights, in Pounds			
Section Number	Depth, Inches	Weight per Foot, Pounds	Out to Out of Flanges of Beams, Inches	Center to Center of Beams, Inches	Width of Separator, Inches S	Center to Center, Inches C	Length in Inches	Separators		Bolts and Nuts	
								Separator for Width S	Increase for 1-inch Additional Spread of Beams	Bolts and Nuts for Width S	Increase for 1-inch Additional Spread of Beams
G-30-a	30	200.0	30 $\frac{3}{4}$	15 $\frac{3}{4}$	15	10	17 $\frac{1}{2}$	73.0	4.50	7.7	.375
G-30	30	180.0	26 $\frac{3}{4}$	13 $\frac{3}{4}$	13	10	15 $\frac{1}{2}$	64.5	4.50	7.0	.375
G-28	28	165.0	25 $\frac{3}{4}$	13 $\frac{1}{4}$	12 $\frac{5}{8}$	7 $\frac{1}{2}$	15	59.1	4.15	6.8	.375
G-26-a	26	160.0	27 $\frac{1}{4}$	14 $\frac{1}{4}$	13 $\frac{5}{8}$	7 $\frac{1}{2}$	16	59.0	3.85	7.1	.375
G-26	26	150.0	24 $\frac{3}{4}$	12 $\frac{3}{4}$	12 $\frac{1}{8}$	7 $\frac{1}{2}$	14 $\frac{1}{2}$	53.0	3.85	6.6	.375

SEPARATORS WITH TWO BOLTS

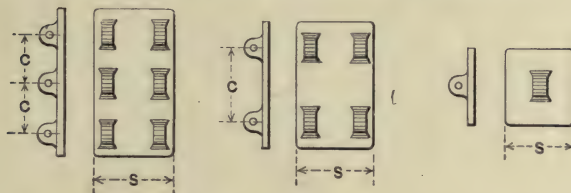
G-24-a	24	140.0	26 $\frac{3}{4}$	13 $\frac{3}{4}$	13 $\frac{1}{8}$	12 $\frac{1}{2}$	15 $\frac{1}{4}$	50.0	3.50	4.6	.25
G-24	24	120.0	24 $\frac{3}{4}$	12 $\frac{3}{4}$	12 $\frac{1}{4}$	12 $\frac{1}{2}$	14 $\frac{1}{4}$	47.0	3.50	4.3	.25
G-20-a	20	140.0	25 $\frac{1}{2}$	13	12 $\frac{3}{8}$	10	14 $\frac{3}{4}$	39.0	2.80	4.5	.25
G-20	20	112.0	24 $\frac{1}{2}$	12 $\frac{1}{2}$	12	10	14	38.0	2.80	4.3	.25
G-18	18	92.0	23 $\frac{1}{2}$	12	11 $\frac{1}{2}$	10	13 $\frac{1}{2}$	34.0	2.60	4.2	.25
G-15-b	15	140.0	24	12 $\frac{3}{4}$	11 $\frac{3}{8}$	7 $\frac{1}{2}$	14	22.0	1.50	4.3	.25
G-15-a	15	104.0	23	11 $\frac{3}{4}$	11 $\frac{1}{8}$	7 $\frac{1}{2}$	13 $\frac{1}{2}$	22.0	1.60	4.2	.25
G-15	15	73.0	21 $\frac{1}{2}$	11	10 $\frac{1}{2}$	7 $\frac{1}{2}$	12 $\frac{1}{2}$	21.0	1.60	4.0	.25
G-12-a	12	70.0	20 $\frac{1}{2}$	10 $\frac{1}{2}$	10	5	12	17.5	1.30	3.8	.25
G-12	12	55.0	20 $\frac{1}{4}$	10 $\frac{3}{8}$	10	5	11 $\frac{3}{4}$	17.5	1.30	3.8	.25

SEPARATORS WITH ONE BOLT

G-10	10	44.0	18 $\frac{1}{2}$	9 $\frac{1}{2}$	9 $\frac{1}{8}$		10 $\frac{3}{4}$	11.0	1.10	1.8	.125
G-9	9	38.0	17 $\frac{1}{2}$	9	8 $\frac{3}{4}$		10 $\frac{1}{4}$	10.0	1.00	1.7	.125
G-8	8	32.5	16 $\frac{1}{2}$	8 $\frac{1}{2}$	8 $\frac{1}{4}$		9 $\frac{3}{4}$	8.0	.85	1.7	.125

All bolts $\frac{3}{4}$ -inch diameter.

CAST IRON SEPARATORS FOR BETHLEHEM I-BEAMS



Separators for 18 to 30-inch beams are $\frac{5}{8}$ -inch metal.
Separators for 8 to 15-inch beams are $\frac{1}{2}$ -inch metal.

SEPARATORS WITH THREE BOLTS

Designation of Beam			Distances			Bolts		Weights, in Pounds			
Section Number	Depth, Inches	Weight per Foot, Pounds	Out to Out of Flanges of Beams, Inches	Center to Center of Beams, Inches	Width of Separator, Inches	Center to Center in Inches	Length in Inches	Separators		Bolts and Nuts	
								Separator for Width	Increase for 1-inch Additional Spread of Beams	Bolts and Nuts for Width	Increase for 1-inch Additional Spread of Beams
								S	S	S	S
B-30	30	120.0	21 $\frac{3}{4}$	11 $\frac{1}{4}$	10 $\frac{3}{4}$	10	12 $\frac{3}{4}$	50.1	4.50	6.0	.375
B-28	28	105.0	20 $\frac{5}{8}$	10 $\frac{5}{8}$	10 $\frac{1}{8}$	7 $\frac{1}{2}$	12	43.9	4.15	5.7	.375
B-26	26	90.0	19 $\frac{5}{8}$	10 $\frac{1}{8}$	9 $\frac{5}{8}$	7 $\frac{1}{2}$	11 $\frac{1}{2}$	39.3	3.85	5.5	.375

SEPARATORS WITH TWO BOLTS

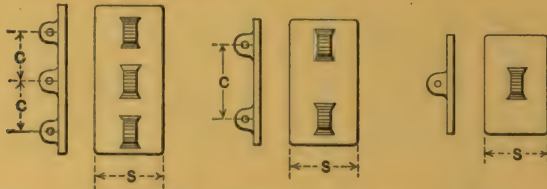
B-24-a	24	84.0	19	9 $\frac{3}{4}$	9 $\frac{1}{4}$	12 $\frac{1}{2}$	11 $\frac{1}{4}$	35.1	3.65	3.6	.25
B-24	24	73.0	18 $\frac{5}{8}$	9 $\frac{5}{8}$	9 $\frac{1}{4}$	12 $\frac{1}{2}$	11	35.1	3.65	3.6	.25
B-20-a	20	72.0	18 $\frac{1}{8}$	9 $\frac{5}{8}$	9	10	10 $\frac{3}{4}$	28.2	3.00	3.5	.25
B-20	20	59.0	16 $\frac{5}{8}$	8 $\frac{5}{8}$	8 $\frac{1}{4}$	10	10	26.1	3.00	3.4	.25
B-18	18	48.5	15 $\frac{1}{2}$	8	7 $\frac{5}{8}$	10	9 $\frac{1}{4}$	22.1	2.70	3.2	.25
B-15-b	15	71.0	15 $\frac{1}{2}$	8	7 $\frac{1}{2}$	7 $\frac{1}{2}$	9 $\frac{1}{2}$	13.1	1.65	3.2	.25
B-15-a	15	54.0	14 $\frac{1}{2}$	7 $\frac{1}{2}$	7	7 $\frac{1}{2}$	9	12.3	1.65	3.1	.25
B-15	15	38.0	14	7 $\frac{1}{4}$	7	7 $\frac{1}{2}$	8 $\frac{1}{2}$	13.3	1.80	3.0	.25
B-12-a	12	36.0	13 $\frac{1}{16}$	6 $\frac{3}{4}$	6 $\frac{3}{8}$	5	8	9.1	1.30	2.8	.25
B-12	12	28.5	12 $\frac{5}{8}$	6 $\frac{1}{2}$	6 $\frac{1}{4}$	5	7 $\frac{3}{4}$	9.0	1.30	2.8	.25

SEPARATORS WITH ONE BOLT

B-10	10	23.5	12 $\frac{1}{8}$	6 $\frac{1}{4}$	6		7 $\frac{1}{2}$	7.5	1.10	1.4	.125
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All bolts $\frac{3}{4}$ -inch diameter.

CAST IRON SEPARATORS FOR BETHLEHEM GIRDER BEAMS



Separators for 457 to 762 millimeter beams are 16 millimeter metal.
Separators for 203 to 381 millimeter beams are 13 millimeter metal.

SEPARATORS WITH THREE BOLTS

Designation of Beam			Distances			Bolts		Weights, in Kilograms			
Number of Section	Depth, Millimeters	Weight per Meter, Kilograms	Out to Out of Flanges of Beams in Millimeters	Center to Center of Beams in Millimeters	Width of Separator, Millimeters	Center to Center in Millimeters	Length in Millimeters	Separators		Bolts and Nuts	
								Separator for Width	Increase for One Centimeter Additional Spread of Beams	Bolts and Nuts for Width	Increase for One Centimeter Additional Spread of Beams
								S		S	
G-30-a	762	297.6	781	400	381	254	445	33.1	0.80	3.5	0.07
G-30	762	267.9	678	348	330	254	394	29.3	0.80	3.2	0.07
G-28	711	245.6	656	338	321	191	381	26.8	0.74	3.1	0.07
G-26-a	660	238.1	707	362	346	191	406	26.8	0.69	3.2	0.07
G-26	660	223.2	629	324	308	191	368	24.0	0.69	3.0	0.07

SEPARATORS WITH TWO BOLTS

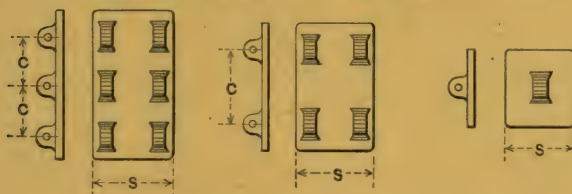
G-24-a	610	208.3	678	348	333	318	387	22.7	0.63	2.1	0.04
G-24	610	178.6	629	324	311	318	362	21.3	0.63	2.0	0.04
G-20-a	508	208.3	648	330	314	254	375	17.7	0.50	2.0	0.04
G-20	508	166.7	624	319	305	254	356	17.2	0.50	2.0	0.04
G-18	457	136.9	596	304	292	254	343	15.4	0.46	1.9	0.04
G-15-b	381	208.3	607	309	289	191	356	10.0	0.27	2.0	0.04
G-15-a	381	154.8	584	298	283	191	343	10.0	0.29	1.9	0.04
G-15	381	108.6	545	278	267	191	318	9.5	0.29	1.8	0.04
G-12-a	305	104.2	520	266	254	127	305	7.9	0.23	1.7	0.04
G-12	305	81.9	511	263	254	127	298	7.9	0.23	1.7	0.04

SEPARATORS WITH ONE BOLT

G-10	254	65.5	469	240	232		273	5.0	0.20	0.8	0.02
G-9	229	56.6	446	230	222		260	4.5	0.18	0.8	0.02
G-8	203	48.4	420	217	210		248	3.6	0.15	0.8	0.02

All bolts 19 millimeters diameter.

CAST IRON SEPARATORS FOR BETHLEHEM I-BEAMS



Separators for 457 to 762 millimeter beams are 16 millimeter metal.
Separators for 203 to 381 millimeter beams are 13 millimeter metal.

SEPARATORS WITH THREE BOLTS

Designation of Beam			Distances			Bolts		Weights, in Kilograms			
Number of Section	Depth, Millimeters	Weight per Meter, Kilograms	Out to Out of Flanges of Beams in Millimeters	Center to Center of Beams in Millimeters	Width of Separator, in Millimeters	Center to Center in Millimeters	Length in Millimeters	Separators		Bolts and Nuts	
								Separator for Width	Increase for One Centimeter Additional Spread of Beams	Bolts and Nuts for Width	Increase for One Centimeter Additional Spread of Beams
					S	C		S		S	
B-30	762	178.6	554	287	273	254	324	22.7	0.80	2.7	0.07
B-28	711	156.3	524	270	257	191	305	19.9	0.74	2.6	0.07
B-26	660	133.9	497	256	244	191	292	17.8	0.69	2.5	0.07

SEPARATORS WITH TWO BOLTS

B-24-a	610	125.0	482	247	235	318	286	15.9	0.65	1.6	0.04
B-24	610	108.6	474	245	235	318	279	15.9	0.65	1.6	0.04
B-20-a	508	107.2	462	240	229	254	273	12.8	0.54	1.6	0.04
B-20	508	87.8	423	220	210	254	254	11.8	0.54	1.5	0.04
B-18	457	72.2	392	202	194	254	235	10.0	0.48	1.5	0.04
B-15-b	381	105.7	395	204	191	191	241	5.9	0.29	1.5	0.04
B-15-a	381	80.4	366	188	178	191	229	5.6	0.29	1.4	0.04
B-15	381	56.6	354	185	178	191	216	6.0	0.32	1.4	0.04
B-12-a	305	53.6	330	170	162	127	203	4.1	0.23	1.3	0.04
B-12	305	42.4	320	165	159	127	197	4.1	0.23	1.3	0.04

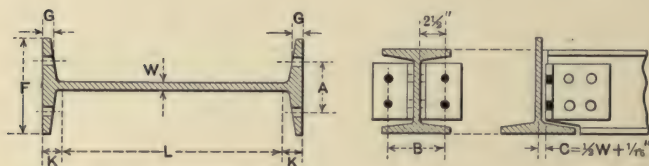
SEPARATORS WITH ONE BOLT

B-10	254	35.0	307	158	152		191	3.4	0.20	0.6	0.02
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All bolts 19 millimeters diameter.

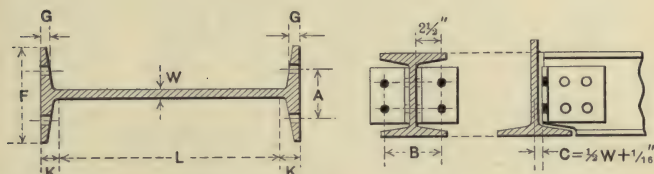
**MISCELLANEOUS
INFORMATION**

DETAIL DIMENSIONS FOR BETHLEHEM I-BEAMS



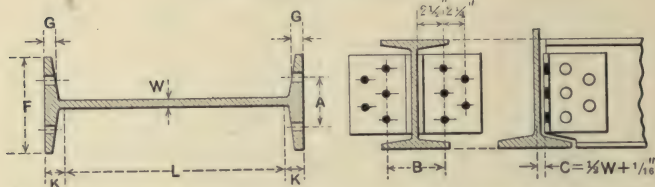
Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Dimensions in Inches								Maximum Rivet or Bolt, Inch
			F	W	L	K	G	A	B	C	
B-30	30	120.0	$10\frac{1}{2}$	$\frac{35}{64}$	$26\frac{7}{16}$	$1\frac{25}{32}$	$\frac{29}{32}$	$6\frac{1}{2}$	$5\frac{9}{16}$	$\frac{5}{16}$	1
B-28	28	105.0	10	$\frac{1}{2}$	$24\frac{11}{16}$	$1\frac{21}{32}$	$\frac{27}{32}$	6	$5\frac{1}{2}$	$\frac{5}{16}$	1
B-26	26	90.0	$9\frac{1}{2}$	$\frac{15}{32}$	23	$1\frac{1}{2}$	$\frac{25}{32}$	$5\frac{1}{2}$	$5\frac{7}{16}$	$\frac{5}{16}$	1
B-24-a	24	84.0	$9\frac{1}{4}$	$\frac{15}{32}$	21	$1\frac{1}{2}$	$\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{7}{8}$
B-24	24	83.0	$9\frac{1}{8}$	$\frac{33}{64}$	$21\frac{5}{16}$	$1\frac{11}{32}$	$\frac{11}{16}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{8}$
	24	73.0	9	$\frac{25}{64}$	$21\frac{5}{16}$	$1\frac{11}{32}$	$\frac{11}{16}$	$5\frac{1}{4}$	$5\frac{3}{8}$	$\frac{1}{4}$	$\frac{7}{8}$
B-20-a	20	82.0	$8\frac{57}{64}$	$\frac{37}{64}$	$17\frac{1}{8}$	$1\frac{7}{16}$	$\frac{3}{4}$	5	$5\frac{9}{16}$	$\frac{3}{8}$	$\frac{7}{8}$
	20	72.0	$8\frac{3}{4}$	$\frac{7}{16}$	$17\frac{1}{8}$	$1\frac{7}{16}$	$\frac{3}{4}$	5	$5\frac{7}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
B-20	20	69.0	$8\frac{9}{64}$	$\frac{33}{64}$	$17\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{8}$
	20	64.0	$8\frac{5}{64}$	$\frac{29}{64}$	$17\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	$4\frac{1}{2}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{7}{8}$
	20	59.0	8	$\frac{3}{8}$	$17\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	$4\frac{1}{2}$	$5\frac{3}{8}$	$\frac{1}{4}$	$\frac{7}{8}$
B-18	18	59.0	$7\frac{43}{64}$	$\frac{1}{2}$	$15\frac{3}{4}$	$1\frac{1}{8}$	$\frac{9}{16}$	$4\frac{1}{4}$	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{8}$
	18	54.0	$7\frac{19}{32}$	$\frac{19}{32}$	$15\frac{3}{4}$	$1\frac{1}{8}$	$\frac{9}{16}$	$4\frac{1}{4}$	$5\frac{7}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
	18	52.0	$7\frac{9}{16}$	$\frac{3}{8}$	$15\frac{3}{4}$	$1\frac{1}{8}$	$\frac{9}{16}$	$4\frac{1}{4}$	$5\frac{3}{8}$	$\frac{1}{4}$	$\frac{7}{8}$
	18	48.5	$7\frac{1}{2}$	$\frac{21}{64}$	$15\frac{3}{4}$	$1\frac{1}{8}$	$\frac{9}{16}$	$4\frac{1}{4}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{7}{8}$

DETAIL DIMENSIONS FOR BETHLEHEM I-BEAMS



Section Number	Depth of Beam, Inches	Weight per Foot, Pounds	Dimensions in Inches								Maximum Rivet or Bolt, Inch
			F	W	L	K	G	A	B	C	
B-15-b	15	71.0	$7\frac{1}{2}$	$3\frac{3}{64}$	$11\frac{3}{4}$	$1\frac{5}{8}$	$\frac{15}{16}$	$4\frac{1}{4}$	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{8}$
B-15-a	15	64.0	$7\frac{3}{16}$	$3\frac{9}{64}$	$12\frac{5}{16}$	$1\frac{11}{32}$	$\frac{3}{4}$	4	$5\frac{5}{8}$	$\frac{3}{8}$	$\frac{7}{8}$
	15	54.0	7	$1\frac{13}{32}$	$12\frac{5}{16}$	$1\frac{11}{32}$	$2\frac{23}{32}$	4	$5\frac{7}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
B-15	15	46.0	$6\frac{13}{16}$	$\frac{7}{16}$	$12\frac{7}{8}$	$1\frac{1}{16}$	$\frac{17}{32}$	$3\frac{3}{4}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{7}{8}$
	15	41.0	$6\frac{23}{32}$	$1\frac{11}{32}$	$12\frac{7}{8}$	$1\frac{1}{16}$	$\frac{17}{32}$	$3\frac{3}{4}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
	15	38.0	$6\frac{21}{32}$	$1\frac{19}{64}$	$12\frac{7}{8}$	$1\frac{1}{16}$	$\frac{17}{32}$	$3\frac{3}{4}$	$5\frac{5}{16}$	$\frac{3}{16}$	$\frac{7}{8}$
B-12-a	12	36.0	$6\frac{19}{64}$	$\frac{5}{16}$	$9\frac{7}{8}$	$1\frac{1}{16}$	$\frac{9}{16}$	$3\frac{1}{2}$	$5\frac{5}{16}$	$\frac{3}{16}$	$\frac{3}{4}$
B-12	12	32.0	$6\frac{3}{16}$	$2\frac{1}{64}$	$10\frac{3}{16}$	$2\frac{29}{32}$	$\frac{7}{16}$	$3\frac{1}{2}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{4}$
	12	28.5	$6\frac{1}{8}$	$\frac{1}{4}$	$10\frac{3}{16}$	$2\frac{29}{32}$	$\frac{7}{16}$	$3\frac{1}{2}$	$5\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{4}$
B-10	10	28.5	$5\frac{63}{64}$	$2\frac{5}{64}$	$8\frac{3}{8}$	$1\frac{13}{16}$	$\frac{3}{8}$	$3\frac{1}{4}$	$5\frac{3}{8}$	$\frac{1}{4}$	$\frac{3}{4}$
	10	23.5	$5\frac{27}{32}$	$\frac{1}{4}$	$8\frac{3}{8}$	$1\frac{13}{16}$	$\frac{3}{8}$	$3\frac{1}{4}$	$5\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{4}$

DETAIL DIMENSIONS FOR BETHLEHEM GIRDER BEAMS



Section Num- ber	Depth of Beam, Inches	Weight per Foot, Pounds	Dimensions in Inches								Maxi- mum Rivet or Bolt, Inch
			F	W	L	K	G	A	B	C	
G-30-a	30	200.0	15	$\frac{3}{4}$	$25\frac{3}{16}$	$2\frac{13}{32}$	$1\frac{1}{8}$	11	$5\frac{3}{4}$	$\frac{7}{16}$	1
G-30	30	180.0	13	$1\frac{1}{16}$	$25\frac{3}{16}$	$2\frac{13}{32}$	$1\frac{1}{32}$	9	$5\frac{11}{16}$	$\frac{7}{16}$	1
G-28	28	165.0	$12\frac{1}{2}$	$2\frac{1}{32}$	$23\frac{3}{8}$	$2\frac{3}{16}$	$1\frac{3}{16}$	$8\frac{1}{2}$	$5\frac{11}{16}$	$\frac{3}{8}$	1
G-26-a	26	160.0	$3\frac{19}{32}$	$\frac{5}{8}$	$21\frac{5}{8}$	$2\frac{3}{16}$	$1\frac{1}{16}$	$9\frac{1}{2}$	$5\frac{5}{8}$	$\frac{3}{8}$	1
G-26	26	150.0	12	$\frac{5}{8}$	$21\frac{5}{8}$	$2\frac{3}{16}$	$1\frac{1}{8}$	8	$5\frac{5}{8}$	$\frac{3}{8}$	1
G-24-a	24	140.0	13	$1\frac{9}{32}$	20	2	$3\frac{1}{32}$	9	$5\frac{5}{8}$	$\frac{3}{8}$	1
G-24	24	120.0	12	$1\frac{7}{32}$	$20\frac{1}{4}$	$1\frac{7}{8}$	$2\frac{9}{32}$	8	$5\frac{1}{2}$	$\frac{5}{16}$	1
G-20-a	20	140.0	$12\frac{1}{2}$	$4\frac{1}{64}$	$15\frac{11}{16}$	$2\frac{3}{32}$	$1\frac{1}{8}$	$8\frac{1}{2}$	$5\frac{5}{8}$	$\frac{3}{8}$	1
G-20	20	112.0	12	$3\frac{5}{64}$	$16\frac{3}{8}$	$1\frac{13}{16}$	$\frac{7}{8}$	8	$5\frac{9}{16}$	$\frac{5}{16}$	1
G-18	18	92.0	$11\frac{1}{2}$	$3\frac{1}{64}$	$14\frac{3}{4}$	$1\frac{5}{8}$	$2\frac{5}{32}$	$7\frac{1}{2}$	$5\frac{1}{2}$	$\frac{5}{16}$	1
G-15-b	15	140.0	$11\frac{3}{4}$	$5\frac{1}{64}$	$10\frac{1}{8}$	$2\frac{7}{16}$	$1\frac{9}{32}$	$7\frac{3}{4}$	$5\frac{13}{16}$	$\frac{7}{16}$	1
G-15-a	15	104.0	$11\frac{1}{4}$	$1\frac{9}{32}$	$11\frac{1}{8}$	$1\frac{15}{16}$	$\frac{15}{16}$	$7\frac{1}{4}$	$5\frac{5}{8}$	$\frac{3}{8}$	1
G-15	15	73.0	$10\frac{1}{2}$	$\frac{7}{16}$	$12\frac{1}{16}$	$1\frac{15}{32}$	$1\frac{1}{16}$	$6\frac{1}{2}$	$5\frac{7}{16}$	$\frac{1}{4}$	1
G-12-a	12	70.0	10	$1\frac{5}{32}$	9	$1\frac{1}{2}$	$\frac{3}{4}$	6	$5\frac{7}{16}$	$\frac{5}{16}$	1
G-12	12	55.0	$9\frac{3}{4}$	$\frac{3}{8}$	$9\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{9}{32}$	6	$5\frac{3}{8}$	$\frac{1}{4}$	1
G-10	10	44.0	9	$\frac{5}{16}$	$7\frac{3}{4}$	$1\frac{1}{8}$	$1\frac{7}{32}$	$5\frac{1}{2}$	$5\frac{5}{16}$	$\frac{3}{16}$	$\frac{7}{8}$
G-9	9	38.0	$8\frac{1}{2}$	$1\frac{9}{64}$	$6\frac{7}{8}$	$1\frac{1}{16}$	$1\frac{5}{32}$	$5\frac{1}{4}$	$5\frac{5}{16}$	$\frac{3}{16}$	$\frac{7}{8}$
G-8	8	32.5	8	$1\frac{9}{64}$	6	1	$\frac{7}{16}$	5	$5\frac{5}{16}$	$\frac{3}{16}$	$\frac{7}{8}$

TYPES OF H-COLUMN DETAILS

Fig. 1

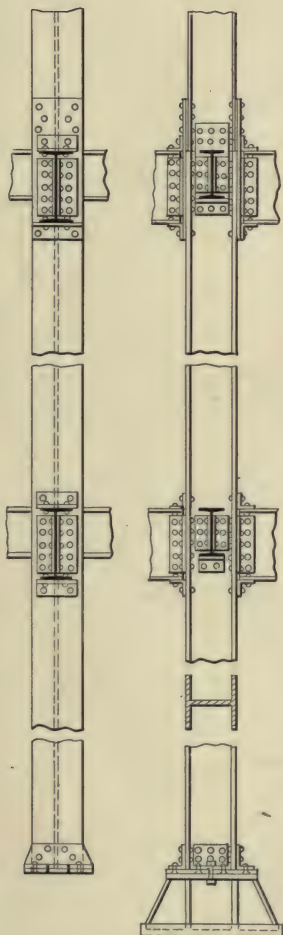
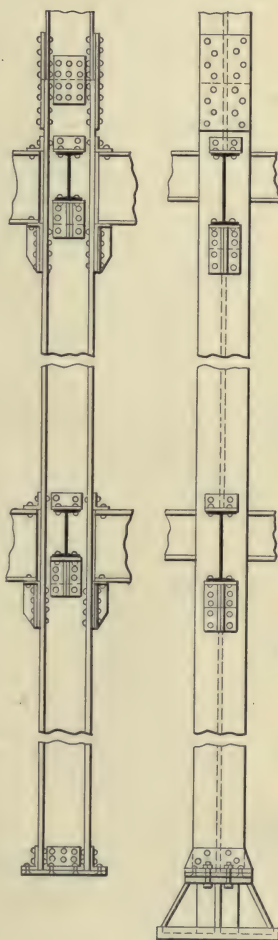
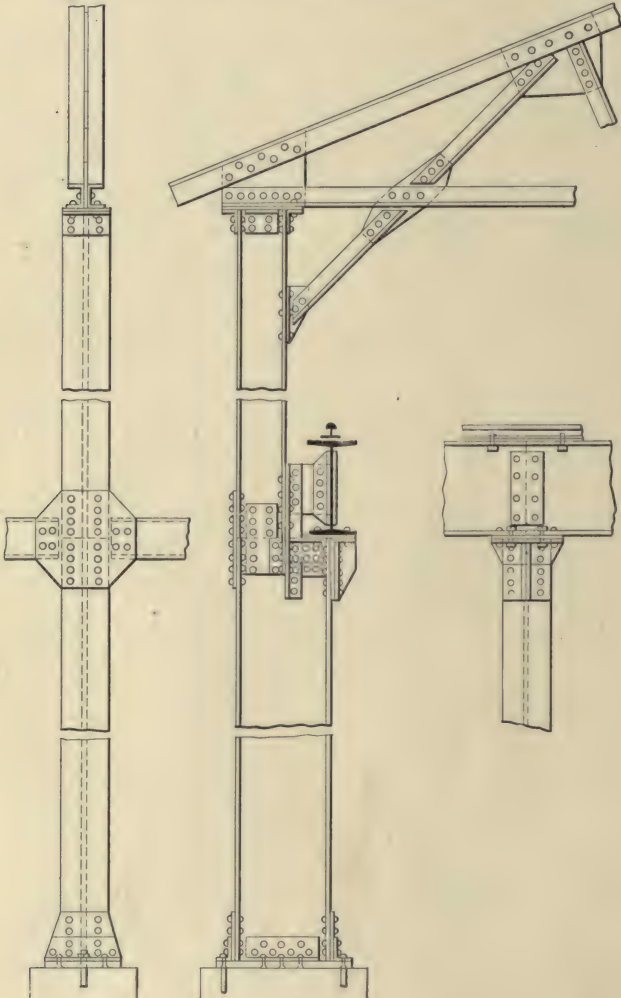


Fig. 2



SHOP BUILDING CONSTRUCTION **WITH BETHLEHEM WIDE FLANGE BEAMS USED FOR COLUMNS** **AND CRANE GIRDERS**



NOTES ON THE STRENGTH AND DEFLECTION OF BEAMS

The general notation employed throughout is as follows:

a = area of section, in square inches.

L = length of span, in feet.

l = length of span, in inches.

W = load uniformly distributed, in pounds.

P = load concentrated at any point, in pounds.

d = depth of cross-section, in inches.

M = bending moment, in foot-pounds.

m = bending moment, in inch-pounds.

n = greatest distance of center of gravity of section from top or from bottom, in inches.

f = stress, in pounds per square inch in extreme fibers of beam, either top or bottom, according as n refers to distance from top or from bottom of section.

D = maximum deflection, in inches.

I = moment of inertia of section, neutral axis through center of gravity.

I' = moment of inertia of section, neutral axis parallel to above, but not through center of gravity.

z = distance between these neutral axes.

S = section modulus.

R = least moment of resistance of section, in inch-pounds.

r = radius of gyration, in inches.

C = coefficient of transverse strength, in pounds.

E = modulus of elasticity (29,000,000 for steel).

For a beam of any cross-section the relations existing between the properties of the section are as follows:

$$I' = I + az^2$$

$$r = \sqrt{\frac{I}{a}}$$

$$S = \frac{I}{n}$$

$$R = \frac{I}{n} f = f S$$

$$C = \frac{2}{3} f S$$

The moment of resistance of the internal stresses of the beam resisting flexure must be equal to the moment of the external forces which act on the beam producing bending. The moment of resistance of a section is usually expressed in inch-pounds, in which case the bending moment must be expressed also in inch-pounds.

The relations existing between bending moment, moment of resistance, section modulus and stress per square inch are expressed thus:

$$m = R$$

$$S = \frac{m}{f}$$

$$m = fS$$

$$f = \frac{m}{S}$$

When the bending moment is in foot-pounds, the following relations are useful:

$$C = 8M$$

$$M = \frac{C}{8}$$

If W is a uniformly distributed load in pounds, and the span, L , is taken in feet, then:

$$C = WL$$

$$W = \frac{C}{L}$$

The last two formulas are convenient. To find the safe uniformly distributed load in pounds for any section, it is only necessary to divide its coefficient of strength by the span in feet. If the uniformly distributed load in pounds is given, multiply it by the span in feet and the result is the coefficient of strength required by the section.

On the next page formulas are given for finding bending moments, safe loads and deflections for beams loaded and supported in usual ways. Bending moments will be in foot-pounds or inch-pounds according as the lengths are taken in feet or inches. To obtain deflection in inches the lengths must be taken in inches.

For illustration, take a center load of 30,000 pounds on a span of 20 feet:

$$M = \frac{30,000 \times 20}{4} = 150,000 \text{ foot-pounds}$$

$$C = 8M = 8 \times 150,000 = 1,200,000$$

The nearest beam is a 20-inch Bethlehem I-Beam, weighing 59 pounds per foot, which has a coefficient of 1,250,300.

If the bending moment has been taken in inch-pounds, then

$$m = \frac{30,000 \times 240}{4} = 1,800,000 \text{ inch-pounds}$$

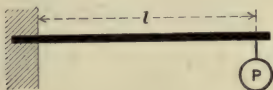
$$S = \frac{m}{f} = 1,800,000 \div 16,000 = 112.5$$

The beam selected by the first method has a section modulus of 117.2, which is the nearest to that required. Both methods of calculation give identical results.

BENDING MOMENTS AND DEFLECTIONS OF BEAMS FOR USUAL METHODS OF LOADING

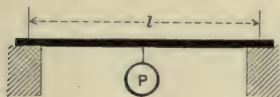
P or W = total load
 l = length of beam

- (1) Beam fixed at one end and loaded at the other.



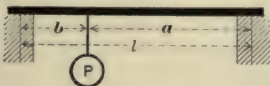
Safe load = $\frac{1}{8}$ that given in tables.
Maximum bending moment at point of support = Pl .
Maximum shear at point of support = P .
Deflection = $\frac{Pl^3}{3EI}$.

- (3) Beam supported at both ends, single load in the middle.



Safe load = $\frac{1}{2}$ that given in tables.
Maximum bending moment at middle of beam = $\frac{Pl}{4}$.
Maximum shear at points of support = $\frac{1}{2}P$.
Deflection = $\frac{Pl^3}{48EI}$.

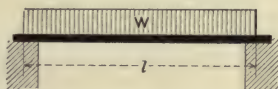
- (5) Beam supported at both ends, single unsymmetrical load.



Safe load = that given in tables $\times \frac{l^3}{8ab}$.
Maximum bending moment under load = $\frac{Pab}{l}$.
Maximum shears: at support, a end = $\frac{Pb}{l}$;
at other support = $\frac{Pa}{l}$.
Maximum deflection = $\frac{Pab(2l-a)}{9EI} \sqrt{\frac{1}{3}a(2l-a)}$.

I = moment of inertia
 E = modulus of elasticity

- (2) Beam fixed at one end and uniformly loaded.



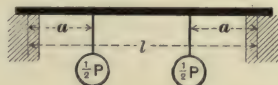
Safe load = $\frac{1}{4}$ that given in tables.
Maximum bending moment at point of support = $\frac{Wl}{2}$.
Maximum shear at point of support = W .
Deflection = $\frac{Wl^3}{8EI}$.

- (4) Beam supported at both ends and uniformly loaded.



Safe load = that given in tables.
Maximum bending moment at middle of beam = $\frac{Wl}{8}$.
Maximum shear at points of support = $\frac{1}{2}W$.
Deflection = $\frac{5Wl^3}{384EI}$.

- (6) Beam supported at both ends, two symmetrical loads.



Safe load = that given in tables $\times \frac{l}{4a}$.
Maximum bending moment between loads = $\frac{1}{2}Pa$.
Maximum shear between load and nearer support = $\frac{1}{2}P$.
Maximum deflection = $\frac{Pa}{48EI} (3l^3 - 4a^3)$.

DEFLECTION OF STEEL BEAMS AND GIRDERS UNDER TRANSVERSE LOADS

Using the notation given on page 159, the deflection, in inches, of a steel beam or other section under a uniformly distributed load of W , in pounds, is found from the formula—

$$D = \frac{5}{384} \frac{Wl^3}{EI} = \frac{5}{384} \frac{W(12L)^3}{EI}$$

When W is the safe uniformly distributed load corresponding to a coefficient of strength C , the following relations exist between W and C and the properties of the shape:

$$W = \frac{C}{L} \quad \text{and} \quad C = \frac{2}{3} f S = \frac{2}{3} f \frac{I}{n}$$

Substituting these values in the above formula, then,

$$D = \frac{15fL^2}{nE}$$

When the fiber stress is 16,000 pounds per square inch and the modulus of elasticity of steel taken as 29,000,000, then the deflection, in inches, is given by the formula—

$$D = \frac{0.01655L^2}{2n}$$

In the case of a beam, girder or other section symmetrical about its neutral axis, $2n$ equals the depth of the beam. The deflection, in inches, of such a section under its safe uniformly distributed load which produces a fiber stress of 16,000 pounds per square inch is given by the simple formula—

$$D = \frac{0.01655L^2}{d} \quad \text{or very nearly} = \frac{1}{60} \frac{L^2}{d}$$

The table on the opposite page gives the value of the expression $0.01655L^2$ for spans from 1 foot to 60 feet.

The safe loads and corresponding deflections for other usual cases of loading, as compared with the safe uniformly distributed loads given in the tables, are as follows:

Beam supported at both ends and loaded with a single load concentrated at center of span. Safe load = $\frac{1}{2}$ tabular load. Deflection = $\frac{8}{15}$.

Cantilever beam, fixed at one end and unsupported at the other, uniformly loaded. Safe load = $\frac{1}{4}$ tabular load. Deflection = $2\frac{4}{15}$.

Cantilever beam, fixed at one end and unsupported at the other, single load concentrated at free end. Safe load = $\frac{1}{8}$ tabular load. Deflection = $3\frac{2}{15}$.

DEFLECTION COEFFICIENTS FOR UNIFORMLY DISTRIBUTED LOADS

Fiber Stress, 16,000 Pounds per Square Inch

Length of Span, Feet	Deflection Coefficient	Length of Span, Feet	Deflection Coefficient	Length of Span, Feet	Deflection Coefficient	Length of Span, Feet	Deflection Coefficient
1	.0166	16	4.2372	31	15.9062	46	35.0234
2	.0662	17	4.7834	32	16.9490	47	36.5628
3	.1490	18	5.3628	33	18.0248	48	38.1352
4	.2648	19	5.9752	34	19.1338	49	39.7407
5	.4138	20	6.6207	35	20.2759	50	41.3793
6	.5959	21	7.2993	36	21.4510	51	43.0510
7	.8110	22	8.0110	37	22.6593	52	44.7559
8	1.0593	23	8.7559	38	23.9007	53	46.4938
9	1.3407	24	9.5338	39	25.1752	54	48.2648
10	1.6552	25	10.3448	40	26.4828	55	50.0690
11	2.0028	26	11.1890	41	27.8234	56	51.9062
12	2.3834	27	12.0662	42	29.1972	57	53.7766
13	2.7972	28	12.9766	43	30.6041	58	55.6800
14	3.2441	29	13.9200	44	32.0441	59	57.6166
15	3.7241	30	14.8966	45	33.5172	60	59.5862

These coefficients furnish a convenient means of finding the deflection of steel sections under their uniformly distributed safe loads for a maximum fiber stress of 16,000 pounds per square inch.

To find the deflection of a steel beam, girder, or other section which is symmetrical about its neutral axis, under the above condition of loading, divide the deflection coefficient found in the above table for the given span by the depth of the beam in inches. The quotient will be the deflection in inches.

To find the deflection of an angle or other section which is not symmetrical about its neutral axis under the above condition of loading, divide the deflection coefficient in the table for the given span by twice the greatest distance, in inches, of the neutral axis from the outside fiber in the direction of bending.

Under uniformly distributed loading corresponding to other intensities of stress the deflection can be found by simple proportion. Thus, for a uniformly distributed load producing a fiber stress of 12,000 pounds per square inch the deflection will be $\frac{12000}{16000}$ or $\frac{3}{4}$ of that found by the use of the above coefficients.

DEFLECTION COEFFICIENTS FOR UNIFORMLY DISTRIBUTED LOADS

Fiber Stress, 1200 Kilograms per Square Centimeter

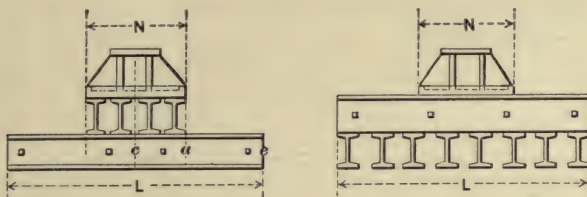
Length of Span, Meters	Deflection Coefficients	Length of Span, Meters	Deflection Coefficients	Length of Span, Meters	Deflection Coefficients
1.0	123	7.5	6,897	14.0	24,031
1.5	276	8.0	7,847	14.5	25,779
2.0	490	8.5	8,859	15.0	27,587
2.5	766	9.0	9,931	15.5	29,457
3.0	1,104	9.5	11,066	16.0	31,388
3.5	1,502	10.0	12,261	16.5	33,380
4.0	1,962	10.5	13,518	17.0	35,434
4.5	2,483	11.0	14,836	17.5	37,549
5.0	3,065	11.5	16,215	18.0	39,725
5.5	3,709	12.0	17,656	18.5	41,963
6.0	4,414	12.5	19,158	19.0	44,262
6.5	5,180	13.0	20,721	19.5	46,622
7.0	6,008	13.5	22,346	20.0	49,044

These coefficients furnish a convenient means of finding the deflection of steel sections under their uniformly distributed safe loads for a maximum fiber stress of 1200 kilograms per square centimeter.

To find the deflection of a steel beam, girder or other section which is symmetrical about its neutral axis, under the above condition of loading, divide the deflection coefficient found in the above table for the given span by the depth of the beam in millimeters. The quotient will be the deflection in millimeters.

Under uniformly distributed loading, corresponding to other intensities of stress, the deflection can be found by simple proportion. Thus, for a uniformly distributed load producing a fiber stress of 900 kilograms per square centimeter, the deflection will be $\frac{900}{1200}$ or $\frac{3}{4}$ of that found by the use of the above coefficients.

GRILLAGE BEAMS IN FOUNDATIONS



Grillages of steel beams imbedded in concrete are used in column footings to distribute the load over the desired area on yielding soil, thereby avoiding large masses of masonry and deep excavations. The beams should not be less than 3 inches apart in the clear between flanges so that the space between beams can be thoroughly filled with concrete. Separators should be used to keep the beams properly spaced.

The load supported by each beam in a layer equals the total load on the foundation divided by the number of beams in the layer. Loading is uniformly distributed over the length on which it is applied and the beam is uniformly supported from below over its entire length. Maximum bending occurs at c , the center of length of the beam.

W = load supported by each beam, in pounds.

L = length of beam, in feet.

N = length, in feet, on which load is applied.

C = coefficient of strength for the beam.

Maximum bending moment in foot-pounds = $\frac{1}{8}W(L-N)$.

This formula for bending moment is the same as that for a simple beam of the length $(L-N)$ supporting a uniformly distributed load of W . By using the length $(L-N)$ as the span the size or safe load of grillage beams may be obtained directly from the tables of safe loads for I-beams and girder beams. If $(L-N)$ is less than the spans given in these tables the size or safe load must be obtained by means of the coefficient of strength or section modulus. When W is in pounds and L and N are in feet, the safe load on a given grillage beam is found by the formula—

$$W = \frac{C}{L-N}; \quad (1)$$

and the coefficient of strength required by a beam for a given loading from the formula—

$$C = W(L-N). \quad (2)$$

The greatest safe load may be limited by the safe shearing or crippling strength of the web, which should be investigated. The shear due to the load W is a maximum at the point a under the outer edge of the superimposed load, and is found as follows:

V_s = maximum shear due to the load W .

V = greatest safe allowable shear on web of beam.

$$V_s = \frac{W(L-N)}{2L}$$

The shear V_s must not exceed V , the safe shearing strength of the web. If the beams are thoroughly imbedded in concrete and the webs prevented from buckling,

$$V = 12,000dt = \text{safe allowable shear, in pounds.}$$

But if the webs are not supported against buckling,

$$V = \frac{12,000dt}{1 + \frac{h^2}{3000t^2}} = \left\{ \begin{array}{l} \text{safe crippling strength of} \\ \text{web, in pounds,} \end{array} \right.$$

where d = depth of beam, t = thickness of web and h = clear distance between flanges, all in inches. The last formula is that for the safe crippling strength of webs and values for it are given for Bethlehem Beam and Girder Sections in the tables on pages 128 and 129.

When shearing strength of the web is considered, the maximum load on a given grillage beam is

$$W = 2V \frac{L}{L-N}; \quad (3)$$

and the safe shearing strength required by the web of a beam for a given loading is

$$V = \frac{W}{2} \frac{L-N}{L}. \quad (4)$$

To find the safe load on a given beam use formulas (1) and (3) and take the lesser of the two values. When formula (3) gives the smaller value the safe load is limited by the shearing strength of the web.

To select a grillage beam for a given loading find the coefficient of strength required by formula (2) and the safe shearing strength of web required by formula (4). The proper beam must then be selected to satisfy both requirements.

It will be found that Bethlehem Girder Beams are desirable and economical for use as grillage beams.

BEARING PLATES

Steel bearing plates are used under the ends of steel beams resting on walls to distribute the pressure on the latter. The plate must be of a sufficient size so that the allowable safe pressure on the wall will not be exceeded.

For good brick work laid in cement mortar, capable of sustaining a safe pressure of 200 pounds per square inch, the table below gives standard sizes of bearing plates which will suffice in general on ordinary spans for I-beams to 24 up inches in depth.

STANDARD BEARING PLATES FOR I-BEAMS

Depth of Beam, Inches	Bearing on Wall, Inches	Size of Bearing Plates			Safe End Reaction at 200 Pounds per Square Inch, Tons	Weight of Bearing Plate, Pounds
		Length, Inches	Width, Inches	Thickness, Inches		
24	16	16	16	$\frac{7}{8}$	25.6	64
20	16	16	15	$\frac{7}{8}$	24.0	60
18	16	16	14	$\frac{7}{8}$	22.4	56
15	12	12	14	$\frac{7}{8}$	16.8	42
12	12	12	12	$\frac{3}{4}$	14.4	31
10	10	10	10	$\frac{5}{8}$	10.0	18
9	8	8	9	$\frac{1}{2}$	7.2	11
8	8	8	8	$\frac{1}{2}$	6.4	9
7	8	8	8	$\frac{1}{2}$	6.4	9
6	6	6	6	$\frac{1}{2}$	3.6	5
and less						

Larger I-beams, girder beams and girders will require plates of increased size. In such special cases the size of the bearing plate must be determined by the area required to distribute the pressure and its thickness then obtained by the following formula:

$$t = \frac{1}{2} (w-b) \sqrt{\frac{3p}{f}},$$

in which

t = thickness of plate, in inches.

w = width of plate perpendicular to beam, in inches.

b = width of flange of beam, in inches.

p = allowable pressure on wall, in pounds per square inch.

f = allowable fiber stress in plate, in pounds per square inch.

For an allowable stress of 16,000 pounds per square inch the thickness of the plate required can be obtained for various pressures by multiplying $\frac{1}{2} (w-b)$, or the cantilever projection of the plate, by the following coefficients:

Pressure, pounds square inch.....	100	150	200	350	500
Coefficient.....	0.137	0.168	0.194	0.256	0.306

BEARING VALUES OF PLATES

IN TONS OF 2000 POUNDS

Size of Plate, Inches	Allowable Pressure per Square Inch					Size of Plate, Inches	Allowable Pressure per Square Inch				
	100 Pounds	150 Pounds	200 Pounds	350 Pounds	500 Pounds		100 Pounds	150 Pounds	200 Pounds	350 Pounds	500 Pounds
6x 6	1.8	2.7	3.6	5.3	9.0	14x14	9.8	14.7	19.6	34.3	49.0
6x 8	2.4	3.6	4.8	8.4	12.0	14x16	11.2	16.8	22.4	39.2	56.0
6x10	3.0	4.5	6.0	10.5	15.0	14x18	12.6	18.9	25.2	44.1	63.0
8x 8	3.2	4.8	6.4	11.2	16.0	16x16	12.8	19.2	25.6	44.8	64.0
8x10	4.0	6.0	8.0	14.0	20.0	16x18	14.4	21.6	28.8	50.4	72.0
8x12	4.8	7.2	9.6	16.8	24.0	16x20	16.0	24.0	32.0	56.0	80.0
10x10	5.0	7.5	10.0	17.5	25.0	18x18	16.2	24.3	32.4	56.7	81.0
10x12	6.0	9.0	12.0	21.0	30.0	18x20	18.0	27.0	36.0	63.0	90.0
10x14	7.0	10.5	14.0	24.5	35.0	18x22	19.8	29.7	39.6	69.3	99.0
12x12	7.2	10.8	14.4	25.2	36.0	20x20	20.0	30.0	40.0	70.0	100.0
12x14	8.4	12.6	16.8	29.4	42.0	20x22	22.0	33.0	44.0	77.0	110.0
12x16	9.6	14.4	19.2	33.6	48.0	20x24	24.0	36.0	48.0	84.0	120.0

The pressure on masonry of different kinds should not exceed the following values, in pounds per square inch:

Kind of Masonry	Pressure, Pounds per Square Inch
Brickwork in lime mortar.....	100
Brickwork in cement and lime mortar.....	150
Brickwork in Portland cement mortar.....	200
Portland cement concrete.....	350
Sandstone of good quality.....	400
Bluestone and limestone.....	500
Granite.....	600

Frequently a template of bluestone, or other hard quality of stone, is used instead of a steel bearing plate. Where the load to be supported is considerable, as at the ends of girders, both steel bearing plates and stone templates should be used; in which case the size of the bearing plate is determined by the allowable pressure on the stone template according to the safe pressure given above for the kind of stone used. The size of the stone template must also be sufficient to limit the pressure on the brickwork to the safe allowable value as given above for the quality of masonry used. The stone should not project beyond the steel bearing plate in any direction more than $\frac{3}{4}$ of the thickness of the stone.

SPACING OF TIE RODS

Tie rods are used in fireproof floors to resist the thrust of the floor arches and to hold the steel beams in position laterally. Rods of $\frac{3}{4}$ -inch diameter are generally employed for this purpose. They should be placed as near as possible in the line of thrust of the arch, usually 3 inches above the bottom of the beams.

The proper spacing of tie rods is determined by two considerations. The stress on the net area of the rod produced by the thrust of the arch must not exceed 15,000 pounds per square inch. Also the lateral stress produced in the beams or channels by the thrust of the arches must not be excessive.

The spacing required to satisfy the first of these requirements is found in the following manner:

Let t = thrust of arch, in pounds per lineal foot.

r = rise of arch, in inches.

l = distance between beams, or span of arch, in feet.

w = load per square foot, in pounds.

a = net area of tie rod, in square inches.

d = distance between tie rods, in feet.

$$\text{Then, } t = \frac{3wl^2}{2r}, \quad (1); \text{ and } d = \frac{10,000ar}{wl^2}, \quad (2).$$

The net areas, in square inches, of the usual sizes of tie rods are as follows:

Diameter of rod =	$\frac{5}{8}$ -inch	$\frac{3}{4}$ -inch	$\frac{7}{8}$ -inch	1-inch
Net area, a =	0.20	0.30	0.42	0.55

For $\frac{3}{4}$ -inch rods, the size generally used, and for a total load of 150 pounds per square foot the spacing given by formula (2) becomes $d = 20r \div l^2$.

The effective rise of flat tile arches may be assumed as 2 inches less than the depth of the arch.

The maximum spacing, in feet, of $\frac{3}{4}$ -inch tie rods for a total load of 150 pounds per square foot, producing a stress of 15,000 pounds per square inch in net area of rods, is given in the following table:

MAXIMUM SPACING, IN FEET, OF $\frac{3}{4}$ -INCH TIE RODS FOR A TOTAL LOAD OF 150 POUNDS PER SQUARE FOOT

Span of Arch, Feet	Effective Rise of Arch							
	3 Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch
4	3.7	5.0	6.2	7.5	8.7	10.0	11.2	12.5
5	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
6		2.2	2.8	3.3	3.9	4.4	5.0	5.5
7			2.0	2.4	2.9	3.3	3.7	4.1
8					2.2	2.5	2.8	3.1

It may be necessary to decrease the distance between tie rods given in the preceding table or found from formula (2), in order to satisfy the second requirement that the lateral stress in the beams or channels produced by the thrust of the arches may not be excessive.

Let I' = moment of inertia of beam or channel, sideways.

b = width of flange of beam or channel, in inches.

x = distance, in inches, of neutral axis from back of channel.

f = fiber stress produced by thrust of arch, in pounds per square inch.

The beams or channels may be considered as continuous, in which case the stress produced by flexure and the corresponding spacing of rods are given by the following formulas:

$$\text{For Beams, } f = \frac{td^2b}{2I'}, \quad (3); \quad \text{and} \quad d = \sqrt{\frac{2fI'}{tb}}, \quad (4)$$

$$\text{For Channels, } f = \frac{td^2(b-x)}{I'}, \quad (5); \quad \text{and} \quad d = \sqrt{\frac{fI'}{t(b-x)}}, \quad (6)$$

Where the thrusts of adjacent arches are opposed to each other, as in the interior beams of a floor, the thrust t in these formulas may be taken only for the live loads. The sum of the stresses produced by lateral thrust and vertical loading should not exceed 20,000 pounds per square inch. As the vertical loading in building construction is usually allowed to produce a fiber stress of 16,000 pounds per square inch, the lateral stress must therefore be limited to 4,000 pounds per square inch. In such case the fiber stress, f , in formula (4) is to be taken as 4,000.

For exterior arches along walls, or around openings, the thrust t must be taken for the full live and dead load.

Channels will be found to require a greater number of tie rods than interior beams, and it may be advisable in some instances to use a beam for a skewback instead of a channel.

If formulas (4) and (6) give a greater distance between rods than is obtained by the use of formula (2), the value given by the latter is to be used, as the stress on the tie rod itself must not exceed its safe limit.

Beams must be held laterally at intervals not greater than twenty times the width of their flanges, otherwise their safe loads as given in the tables must be reduced in the proportion given in the table at the bottom of page 77.

REDUCTION OF AREA FOR ONE RIVET HOLE

IN SQUARE INCHES

To be deducted from gross area of plates or shapes to obtain net area

Thickness of Metal, Inches	Diameter of Hole										
	$\frac{1}{2}$ Inch	$\frac{3}{16}$ Inch	$\frac{5}{16}$ Inch	$\frac{11}{16}$ Inch	$\frac{3}{4}$ Inch	$\frac{13}{16}$ Inch	$\frac{7}{8}$ Inch	$\frac{15}{16}$ Inch	1 Inch	$1\frac{1}{8}$ Inch	$1\frac{1}{2}$ Inch
$\frac{1}{16}$	.03	.04	.04	.04	.05	.05	.05	.06	.06	.07	.07
$\frac{3}{16}$	.06	.07	.08	.09	.09	.10	.11	.12	.13	.13	.14
$\frac{1}{2}$	.09	.11	.12	.13	.14	.15	.16	.18	.19	.20	.21
$\frac{3}{4}$	.13	.14	.16	.17	.19	.20	.22	.23	.25	.27	.28
$\frac{5}{16}$	.16	.18	.20	.21	.23	.25	.27	.29	.31	.33	.35
$\frac{3}{8}$	.19	.21	.23	.26	.28	.30	.33	.35	.38	.40	.42
$\frac{7}{16}$	.22	.25	.27	.30	.33	.36	.38	.41	.44	.46	.49
$\frac{1}{2}$	.25	.28	.31	.34	.38	.41	.44	.47	.50	.53	.56
$\frac{9}{16}$	.28	.32	.35	.39	.42	.46	.49	.53	.56	.60	.63
$\frac{5}{8}$	.31	.35	.39	.43	.47	.51	.55	.59	.63	.66	.70
$1\frac{1}{16}$	.34	.39	.43	.47	.52	.56	.60	.64	.69	.73	.77
$\frac{3}{4}$	.38	.42	.47	.52	.56	.61	.66	.70	.75	.80	.84
$1\frac{3}{16}$	.41	.46	.51	.56	.61	.66	.71	.76	.81	.86	.91
$\frac{7}{8}$	.44	.49	.55	.60	.66	.71	.77	.82	.88	.93	.99
$1\frac{5}{16}$	.47	.53	.59	.64	.70	.76	.82	.88	.94	1.00	1.05
1	.50	.56	.63	.69	.75	.81	.88	.94	1.00	1.06	1.13
$1\frac{1}{8}$	.53	.60	.66	.73	.80	.86	.93	1.00	1.06	1.13	1.20
$1\frac{3}{8}$	.56	.63	.70	.77	.84	.91	.98	1.05	1.13	1.20	1.27
$1\frac{5}{8}$	.59	.67	.74	.82	.89	.96	1.04	1.11	1.19	1.26	1.34
$1\frac{3}{4}$	.63	.70	.78	.86	.94	1.02	1.09	1.17	1.25	1.33	1.41
$1\frac{7}{8}$	.66	.74	.82	.90	.98	1.07	1.15	1.23	1.31	1.39	1.48
$1\frac{9}{8}$	.69	.77	.86	.95	1.03	1.12	1.20	1.29	1.38	1.46	1.55
$1\frac{11}{8}$	.72	.81	.90	.99	1.08	1.17	1.26	1.35	1.44	1.53	1.62
$1\frac{1}{2}$	.75	.84	.94	1.03	1.13	1.22	1.31	1.41	1.50	1.59	1.69
$1\frac{13}{8}$	.78	.88	.98	1.07	1.17	1.27	1.37	1.46	1.56	1.66	1.76
$1\frac{5}{4}$	.81	.91	1.02	1.12	1.22	1.32	1.42	1.52	1.63	1.73	1.83
$1\frac{11}{4}$	.84	.95	1.05	1.16	1.27	1.37	1.47	1.58	1.69	1.79	1.90
$1\frac{3}{2}$	.88	.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75	1.86	1.97
$1\frac{13}{4}$	.91	1.02	1.13	1.25	1.36	1.47	1.59	1.70	1.81	1.93	2.04
$1\frac{7}{4}$	.94	1.05	1.17	1.29	1.41	1.52	1.64	1.76	1.88	1.99	2.11
$1\frac{15}{4}$	.97	1.09	1.21	1.33	1.45	1.57	1.70	1.82	1.94	2.06	2.18
2	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	2.13	2.25

When holes are punched the diameter of the holes should be taken $\frac{1}{8}$ inch greater than the diameter of the rivet or bolt.

For drilled holes the diameter may be taken only $\frac{1}{16}$ inch greater than the diameter of the rivet or bolt.

SHEARING AND BEARING VALUE OF RIVETS

Diameter of Rivet, Inches	Area in Square Inches	Single Shear at 7,500 Pounds	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 15,000 Pounds per Square Inch				
			$\frac{1}{4}"$	$\frac{5}{16}"$	$\frac{3}{8}"$	$\frac{7}{16}"$	$\frac{1}{2}"$
$\frac{3}{8}$	.1104	830	1410	1760	2110	.....	.....
$\frac{1}{2}$	.1963	1470	1880	2340	2810	3280	3750
$\frac{5}{8}$	.3068	2300	2340	2930	3520	4100	4690
$\frac{3}{4}$	.4418	3310	2810	3520	4220	4920	5630
$\frac{7}{8}$	.6013	4510	3280	4100	4920	5740	6560
1	.7854	5890	3750	4690	5620	6560	7500

Diameter of Rivet, Inches	Area in Square Inches	Single Shear at 9,000 Pounds	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 Pounds per Square Inch				
			$\frac{1}{4}"$	$\frac{5}{16}"$	$\frac{3}{8}"$	$\frac{7}{16}"$	$\frac{1}{2}"$
$\frac{3}{8}$	.110	990	1680	2110	2530	.....	.....
$\frac{1}{2}$	.196	1770	2250	2820	3370	3940	4500
$\frac{5}{8}$	.307	2760	2790	3480	4180	4870	5580
$\frac{3}{4}$	.442	3970	3370	4210	5050	5910	6750
$\frac{7}{8}$	.601	5410	3940	4920	5910	6880	7870
1	.785	7060	4500	5620	6750	7870	9000

Diameter of Rivet, Inches	Area in Square Inches	Single Shear at 10,000 Pounds	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 Pounds per Square Inch				
			$\frac{1}{4}"$	$\frac{5}{16}"$	$\frac{3}{8}"$	$\frac{7}{16}"$	$\frac{1}{2}"$
$\frac{3}{8}$	.1104	1100	1880	2340	2810	.....	.....
$\frac{1}{2}$	.1963	1960	2500	3130	3750	4380	5000
$\frac{5}{8}$	.3068	3070	3130	3910	4690	5470	6250
$\frac{3}{4}$	.4418	4420	3750	4690	5630	6560	7500
$\frac{7}{8}$	.6013	6010	4380	5470	6570	7660	8750
1	.7854	7850	5000	6250	7500	8750	10000

Diameter of Rivet, Inches	Area in Square Inches	Single Shear at 11,000 Pounds	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 Pounds per Square Inch				
			$\frac{1}{4}"$	$\frac{5}{16}"$	$\frac{3}{8}"$	$\frac{7}{16}"$	$\frac{1}{2}"$
$\frac{3}{8}$	.1104	1210	2060	2580	3090	.....	.....
$\frac{1}{2}$	.1963	2160	2750	3440	4130	4820	5500
$\frac{5}{8}$	.3068	3370	3440	4300	5160	6020	6880
$\frac{3}{4}$	.4418	4860	4130	5160	6190	7220	8250
$\frac{7}{8}$	.6013	6610	4810	6020	7220	8430	9630
1	.7854	8640	5500	6880	8250	9630	11000

Bearing values given above or to the right of the upper zigzag lines are greater than double shear. Bearing values given between the upper and lower zigzag lines are less than double shear and greater than single shear.

SHEARING AND BEARING VALUE OF RIVETS

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 15,000 Pounds per Square Inch								Diameter of Rivet, Inches
$\frac{1}{16}$ Inch	$\frac{5}{8}$ Inch	$\frac{11}{16}$ Inch	$\frac{3}{4}$ Inch	$\frac{13}{16}$ Inch	$\frac{7}{8}$ Inch	$\frac{15}{16}$ Inch	1 Inch	
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{3}{8}$
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{1}{2}$
5,280	5,860	.....	.....	.....	.....	.....	.....	$\frac{5}{8}$
6,330	7,030	7,720	8,440	.....	.....	.....	.....	$\frac{3}{4}$
7,380	8,200	9,030	9,850	10,670	11,480	12,300	.....	$\frac{7}{8}$
8,440	9,380	10,310	11,250	12,190	13,130	14,060	15,000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 Pounds per Square Inch								Diameter of Rivet, Inches
$\frac{1}{16}$ Inch	$\frac{5}{8}$ Inch	$\frac{11}{16}$ Inch	$\frac{3}{4}$ Inch	$\frac{13}{16}$ Inch	$\frac{7}{8}$ Inch	$\frac{15}{16}$ Inch	1 Inch	
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{3}{8}$
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{1}{2}$
6,330	7,030	.....	.....	.....	.....	.....	.....	$\frac{5}{8}$
7,590	8,440	9,280	10,130	.....	.....	.....	.....	$\frac{3}{4}$
8,860	9,840	10,830	11,810	12,800	13,780	14,770	.....	$\frac{7}{8}$
10,120	11,250	12,370	13,500	14,630	15,750	16,880	18,000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 Pounds per Square Inch								Diameter of Rivet, Inches
$\frac{1}{16}$ Inch	$\frac{5}{8}$ Inch	$\frac{11}{16}$ Inch	$\frac{3}{4}$ Inch	$\frac{13}{16}$ Inch	$\frac{7}{8}$ Inch	$\frac{15}{16}$ Inch	1 Inch	
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{3}{8}$
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{1}{2}$
7,030	7,810	.....	.....	.....	.....	.....	.....	$\frac{5}{8}$
8,440	9,380	10,310	11,250	.....	.....	.....	.....	$\frac{3}{4}$
9,840	10,940	12,030	13,130	14,220	15,310	16,410	.....	$\frac{7}{8}$
11,250	12,500	13,750	15,000	16,250	17,500	18,750	20,000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 Pounds per Square Inch								Diameter of Rivet, Inches
$\frac{1}{16}$ Inch	$\frac{5}{8}$ Inch	$\frac{11}{16}$ Inch	$\frac{3}{4}$ Inch	$\frac{13}{16}$ Inch	$\frac{7}{8}$ Inch	$\frac{15}{16}$ Inch	1 Inch	
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{3}{8}$
.....	.....	.....	.....	.....	.....	.....	.....	$\frac{1}{2}$
7,740	8,600	.....	.....	.....	.....	.....	.....	$\frac{5}{8}$
9,280	10,320	11,340	12,380	.....	.....	.....	.....	$\frac{3}{4}$
10,840	12,040	13,240	14,440	15,640	16,840	18,050	.....	$\frac{7}{8}$
12,380	13,750	15,130	16,500	17,880	19,250	20,630	22,000	1

Bearing values given below or to the left of the lower zigzag lines are less than single shear.

SHEARING AND BEARING VALUE OF RIVETS

Thickness of Plate		Bearing Values, in Kilograms, for Different Thickness of Plates at 1200 Kilograms per Square Centimeter					
		Diameter of Rivet					
		$\frac{3}{8}$ Inch	$\frac{1}{2}$ Inch	$\frac{5}{8}$ Inch	$\frac{3}{4}$ Inch	$\frac{7}{8}$ Inch	1 Inch
Inches	Millimeters	9.5 Millimeters	12.7 Millimeters	15.9 Millimeters	19.1 Millimeters	22.2 Millimeters	25.4 Millimeters
$\frac{1}{4}$ "	6.4	725	970	1210	1450	1695	1935
$\frac{5}{16}$ "	7.9	905	1210	1510	1815	2115	2420
$\frac{3}{8}$ "	9.5	1090	1450	1815	2175	2540	2905
$\frac{7}{16}$ "	11.1		1695	2115	2540	2965	3385
$\frac{1}{2}$ "	12.7		1935	2420	2905	3385	3870
$\frac{9}{16}$ "	14.3			2720	3265	3810	4355
$\frac{5}{8}$ "	15.9			3025	3630	4235	4840
$\frac{11}{16}$ "	17.5				3990	4655	5325
$\frac{3}{4}$ "	19.1				4355	5080	5805
$\frac{13}{16}$ "	20.6					5505	6290
$\frac{7}{8}$ "	22.2					5925	6775
$\frac{15}{16}$ "	23.8					6350	7260
1"	25.4						7740
Area of Rivet in Square Centimeters		0.7123	1.2664	1.9794	2.8503	3.8793	5.0671
Single Shear at 600 Kilograms per Centimeter ²		430	760	1190	1710	2330	3040

Thickness of Plate		Bearing Values, in Kilograms, for Different Thickness of Plates at 1500 Kilograms per Square Centimeters					
		Diameter of Rivet					
		$\frac{3}{8}$ Inch	$\frac{1}{2}$ Inch	$\frac{5}{8}$ Inch	$\frac{3}{4}$ Inch	$\frac{7}{8}$ Inch	1 Inch
Inches	Millimeters	9.5 Millimeters	12.7 Millimeters	15.9 Millimeters	19.1 Millimeters	22.2 Millimeters	25.4 Millimeters
$\frac{1}{4}$ "	6.4	905	1210	1510	1815	2115	2420
$\frac{5}{16}$ "	7.9	1135	1510	1890	2270	2645	3025
$\frac{3}{8}$ "	9.5	1360	1815	2270	2720	3175	3630
$\frac{7}{16}$ "	11.1		2115	2645	3175	3705	4235
$\frac{1}{2}$ "	12.7		2420	3025	3630	4235	4840
$\frac{9}{16}$ "	14.3			3400	4085	4765	5445
$\frac{5}{8}$ "	15.9			3780	4535	5290	6050
$\frac{11}{16}$ "	17.5				4990	5820	6655
$\frac{3}{4}$ "	19.1				5445	6350	7260
$\frac{13}{16}$ "	20.6					6880	7865
$\frac{7}{8}$ "	22.2					7410	8470
$\frac{15}{16}$ "	23.8					7940	9075
1"	25.4						9675
Area of Rivet in Square Centimeters		0.7123	1.2664	1.9794	2.8503	3.8793	5.0671
Single Shear of 750 Kilograms per Centimeter ²		535	950	1485	2140	2910	3800

Bearing values gives below or to the left of the lower zigzag lines are greater than double shear. Bearing values given between the upper and lower zigzag lines are less than double shear and greater than single shear.

WEIGHT OF 100 STEEL RIVETS OR ROUND HEAD BOLTS WITHOUT NUTS IN POUNDS

Length, Inches	$\frac{3}{8}$ Inch Diam- eter	$\frac{1}{2}$ Inch Diam- eter	$\frac{5}{8}$ Inch Diam- eter	$\frac{3}{4}$ Inch Diam- eter	$\frac{7}{8}$ Inch Diam- eter	1 Inch Diam- eter	$1\frac{1}{8}$ Inch Diam- eter	$1\frac{1}{4}$ Inch Diam- eter
$1\frac{1}{4}$	5.5	12.8	22.0	29.3	43.9	66.6	93.3	127.0
$1\frac{1}{2}$	6.3	14.2	24.1	32.4	48.2	72.1	100.0	136.0
$1\frac{3}{4}$	7.0	15.5	26.3	35.5	52.5	77.7	107.0	145.0
2	7.9	16.9	28.5	38.7	56.7	83.3	114.0	153.0
$2\frac{1}{4}$	8.7	18.3	30.7	41.8	61.0	88.8	121.0	162.0
$2\frac{1}{2}$	9.4	19.7	32.8	44.9	65.2	94.4	128.0	171.0
$2\frac{3}{4}$	10.2	21.1	35.0	48.0	69.5	100.0	136.0	179.0
3	11.0	22.5	37.2	51.1	73.7	105.0	143.0	188.0
$3\frac{1}{4}$	11.7	23.9	39.3	54.3	78.0	111.0	150.0	197.0
$3\frac{1}{2}$	12.6	25.3	41.5	57.4	82.3	116.0	157.0	205.0
$3\frac{3}{4}$	13.4	26.7	43.7	60.5	86.5	122.0	164.0	214.0
4	14.1	28.1	45.9	63.6	90.8	128.0	170.0	223.0
$4\frac{1}{4}$	14.9	29.4	48.0	66.7	95.0	134.0	177.0	231.0
$4\frac{1}{2}$	15.7	30.8	50.2	69.9	99.3	139.0	185.0	240.0
$4\frac{3}{4}$	16.5	32.2	52.4	73.0	104.0	145.0	192.0	249.0
5	17.2	33.6	54.5	76.1	108.0	150.0	199.0	258.0
$5\frac{1}{4}$	18.1	35.0	56.7	79.2	112.0	156.0	206.0	266.0
$5\frac{1}{2}$	18.8	36.4	58.9	82.3	116.0	161.0	213.0	275.0
$5\frac{3}{4}$	19.6	37.8	61.1	85.5	120.0	166.0	220.0	284.0
6	20.4	39.2	63.2	88.6	124.0	172.0	227.0	292.0
$6\frac{1}{2}$	21.9	42.0	67.6	95.1	133.0	184.0	241.0	310.0
7	23.5	44.7	71.9	101.0	142.0	195.0	255.0	327.0
$7\frac{1}{2}$	25.1	47.5	76.1	108.0	150.0	206.0	269.0	345.0
8	26.6	50.3	80.6	114.0	159.0	217.0	284.0	362.0
$8\frac{1}{2}$	28.2	53.1	85.0	120.0	167.0	227.0	298.0	379.0
9	29.8	55.9	89.3	126.0	176.0	239.0	312.0	397.0
$9\frac{1}{2}$	31.3	58.7	93.7	133.0	185.0	250.0	325.0	414.0
10	32.8	61.4	98.0	139.0	193.0	261.0	340.0	431.0
$10\frac{1}{2}$	34.5	64.2	103.0	145.0	202.0	272.0	354.0	449.0
11	36.0	67.0	107.0	151.0	210.0	284.0	368.0	466.0
$11\frac{1}{2}$	37.6	69.8	111.0	158.0	218.0	295.0	382.0	484.0
12	39.2	72.5	115.0	164.0	227.0	306.0	396.0	501.0
100 Heads	1.8	5.8	11.1	13.6	22.6	39.0	58.0	83.5

WEIGHT OF 100 BOLTS WITH SQUARE HEADS AND NUTS IN POUNDS

Length under Head, Inches	Diameter of Bolts								
	$\frac{1}{4}$ Inch	$\frac{5}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{7}{16}$ Inch	$\frac{1}{2}$ Inch	$\frac{5}{8}$ Inch	$\frac{3}{4}$ Inch	$\frac{7}{8}$ Inch	1 Inch
1 $\frac{1}{2}$	4.0	7.0	10.5	15.2	22.5	39.5	63.0	.....	.....
1 $\frac{3}{4}$	4.4	7.5	11.3	16.3	23.8	41.6	66.0	.....	.....
2	4.8	8.0	12.0	17.4	25.2	43.8	69.0	109.0	163
2 $\frac{1}{4}$	5.2	8.5	12.8	18.5	26.5	45.8	72.0	113.3	169
2 $\frac{1}{2}$	5.5	9.0	13.5	19.6	27.8	48.0	75.0	117.5	174
2 $\frac{3}{4}$	5.8	9.5	14.3	20.7	29.1	50.1	78.0	121.8	180
3	6.3	10.0	15.0	21.8	30.5	52.3	81.0	126.0	185
3 $\frac{1}{2}$	7.0	11.0	16.5	24.0	33.1	56.5	87.0	134.3	196
4	7.8	12.0	18.0	26.2	35.8	60.8	93.1	142.5	207
4 $\frac{1}{2}$	8.5	13.0	19.5	28.4	38.4	65.0	99.1	151.0	218
5	9.3	14.0	21.0	30.6	41.1	69.3	105.2	159.6	229
5 $\frac{1}{2}$	10.0	15.0	22.5	32.8	43.7	73.5	111.3	168.0	240
6	10.8	16.0	24.0	35.0	46.4	77.8	117.3	176.6	251
6 $\frac{1}{2}$	.....	.....	25.5	37.2	49.0	82.0	123.4	185.0	262
7	.....	.....	27.0	39.4	51.7	86.3	129.4	193.7	273
7 $\frac{1}{2}$	.....	.....	28.5	41.6	54.3	90.5	135.0	202.0	284
8	.....	.....	30.0	43.8	59.6	94.8	141.5	210.7	295
9	.....	.....	.....	48.2	64.9	103.3	153.6	227.8	317
10	.....	.....	.....	52.6	70.2	111.8	165.7	244.8	339
11	.....	.....	.....	57.0	75.5	120.3	177.8	261.9	360
12	.....	.....	.....	61.4	80.8	128.8	189.9	278.9	382
14	.....	.....	.....	.....	91.4	145.8	214.1	313.0	426
16	.....	.....	.....	.....	102.0	162.8	238.3	347.1	470
18	.....	.....	.....	.....	112.6	179.5	262.6	381.2	514
20	.....	.....	.....	.....	123.2	206.5	286.8	415.3	558
Per Inch Additional	1.4	2.1	3.1	4.2	5.5	8.5	12.3	16.7	21.8

WEIGHTS OF NUTS AND BOLT HEADS IN POUNDS

Diameter of Bolt in Inches	$\frac{1}{4}$ Inch	$\frac{5}{16}$ Inch	$\frac{3}{8}$ Inch	$\frac{1}{2}$ Inch	$\frac{5}{8}$ Inch	$\frac{3}{4}$ Inch	$\frac{7}{8}$ Inch
Weight of Hexagon Nut and Head.....	.021	.036	.064	.13	.26	.40	.68
Weight of Square Nut and Head.....	.024	.042	.070	.15	.29	.47	.77
Diameter of Bolt in Inches	1 Inch	1 $\frac{1}{4}$ Inch	1 $\frac{1}{2}$ Inch	1 $\frac{3}{4}$ Inch	2 Inch	2 $\frac{1}{2}$ Inch	3 Inch
Weight of Hexagon Nut and Head.....	1.01	2.10	4.26	6.89	9.24	17.3	27.2
Weight of Square Nut and Head.....	1.19	2.39	5.01	8.41	12.93	21.4	33.5

DECIMALS OF AN INCH FOR EACH 1-64th

1-32ds	1-64ths	Decimal	Fraction	1-32ds	1-64ths	Decimal	Fraction
1	1	.015625		17	33	.515625	
	2	.03125			34	.53125	
	3	.046875			35	.546875	
2	4	.0625	1-16	18	36	.5625	9-16
	5	.078125			37	.578125	
3	6	.09375		19	38	.59375	
	7	.109375			39	.609375	
4	8	.125	1-8	20	40	.625	5-8
	9	.140625			41	.640625	
5	10	.15625		21	42	.65625	
	11	.171875			43	.671875	
6	12	.1875	3-16	22	44	.6875	11-16
	13	.203125			45	.703125	
7	14	.21875		23	46	.71875	
	15	.234375			47	.734375	
8	16	.25	1-4	24	48	.75	3-4
	17	.265625			49	.765625	
9	18	.28125		25	50	.78125	
	19	.296875			51	.796875	
10	20	.3125	5-16	26	52	.8125	13-16
	21	.328125			53	.828125	
11	22	.34375		27	54	.84375	
	23	.359375			55	.859375	
12	24	.375	3-8	28	56	.875	7-8
	25	.390625			57	.890625	
13	26	.40625		29	58	.90625	
	27	.421875			59	.921875	
14	28	.4375	7-16	30	60	.9375	15-16
	29	.453125			61	.953125	
15	30	.46875		31	62	.96875	
	31	.484375			63	.984375	
16	32	.5	1-2	32	64	1.	1

DECIMALS OF A FOOT **FOR EACH 1-64th OF AN INCH**

Inch	0 Inch	1 Inch	2 Inch	3 Inch	4 Inch	5 Inch	6 Inch	7 Inch	8 Inch	9 Inch	10 Inch	11 Inch
0	0	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
$\frac{1}{64}$	.0013	.0846	.1680	.2513	.3346	.4180	.5013	.5846	.6680	.7513	.8346	.9180
$\frac{1}{32}$	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193
$\frac{3}{64}$	.0039	.0872	.1706	.2539	.3372	.4206	.5039	.5872	.6706	.7539	.8372	.9206
$\frac{1}{16}$	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219
$\frac{5}{64}$	.0065	.0898	.1732	.2565	.3398	.4232	.5065	.5898	.6732	.7565	.8398	.9232
$\frac{3}{32}$	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245
$\frac{7}{64}$	.0091	.0924	.1758	.2591	.3424	.4258	.5091	.5924	.6758	.7591	.8424	.9258
$\frac{1}{8}$	.0104	.0937	.1771	.2604	.3437	.4271	.5104	.5937	.6771	.7604	.8437	.9271
$\frac{9}{64}$	.0117	.0951	.1784	.2617	.3451	.4284	.5117	.5951	.6784	.7617	.8451	.9284
$\frac{5}{32}$	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297
$\frac{11}{64}$	.0143	.0977	.1810	.2643	.3477	.4310	.5143	.5977	.6810	.7643	.8477	.9310
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323
$\frac{13}{64}$	.0169	.1003	.1836	.2669	.3503	.4336	.5169	.6003	.6836	.7669	.8503	.9336
$\frac{7}{32}$	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349
$\frac{15}{64}$	.0195	.1029	.1862	.2695	.3529	.4362	.5195	.6029	.6862	.7695	.8529	.9362
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375
$\frac{17}{64}$	.0221	.1055	.1888	.2721	.3555	.4388	.5221	.6055	.6888	.7721	.8555	.9388
$\frac{9}{32}$	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401
$\frac{19}{64}$	.0247	.1081	.1914	.2747	.3581	.4414	.5247	.6081	.6914	.7747	.8581	.9414
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427
$\frac{21}{64}$	.0273	.1107	.1940	.2773	.3607	.4440	.5273	.6107	.6940	.7773	.8607	.9440
$\frac{11}{32}$	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453
$\frac{23}{64}$	.0299	.1133	.1966	.2799	.3633	.4466	.5299	.6133	.6966	.7799	.8633	.9466
$\frac{3}{8}$	.0312	.1146	.1979	.2812	.3646	.4479	.5312	.6146	.6979	.7812	.8646	.9479
$\frac{25}{64}$	.0326	.1159	.1992	.2826	.3659	.4492	.5326	.6159	.6992	.7826	.8659	.9492
$\frac{13}{32}$	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	.8672	.9505
$\frac{27}{64}$	.0352	.1185	.2018	.2852	.3685	.4518	.5352	.6185	.7018	.7852	.8685	.9518
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531
$\frac{29}{64}$	.0378	.1211	.2044	.2878	.3711	.4544	.5378	.6211	.7044	.7878	.8711	.9544
$\frac{15}{32}$	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557
$\frac{31}{64}$	.0404	.1237	.2070	.2904	.3737	.4570	.5404	.6237	.7070	.7904	.8737	.9570
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583

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FOR THE CONVERSION OF THE PROPERTIES OF BETHLEHEM AND STANDARD STRUCTURAL SHAPES FROM INCHES TO MILLIMETERS AND VICE-VERSA

I = Moment of inertia in inches⁴

$$T = \left\{ \begin{array}{l} \text{Tragheitsmoment (German).....} \\ \text{Moment d'inertie (French).....} \\ \text{Momento d'inerzia (Italian).....} \\ \text{Momento de inercia (Spanish).....} \end{array} \right\} \text{ in Mm.}^4$$

$$T = 416235 \times I$$

$$I = 0.000,002,402,5 \times T$$

S = Section modulus in inches³

$$W = \left\{ \begin{array}{l} \text{Widerstandmoment (German).....} \\ \text{Moment de resistance (French).....} \\ \text{Momento resistente (Italian).....} \\ \text{Momento resistente (Spanish).....} \end{array} \right\} \text{ in Mm.}^3$$

$$W = 16387 \times S$$

$$S = 0.000,061,023 \times W$$

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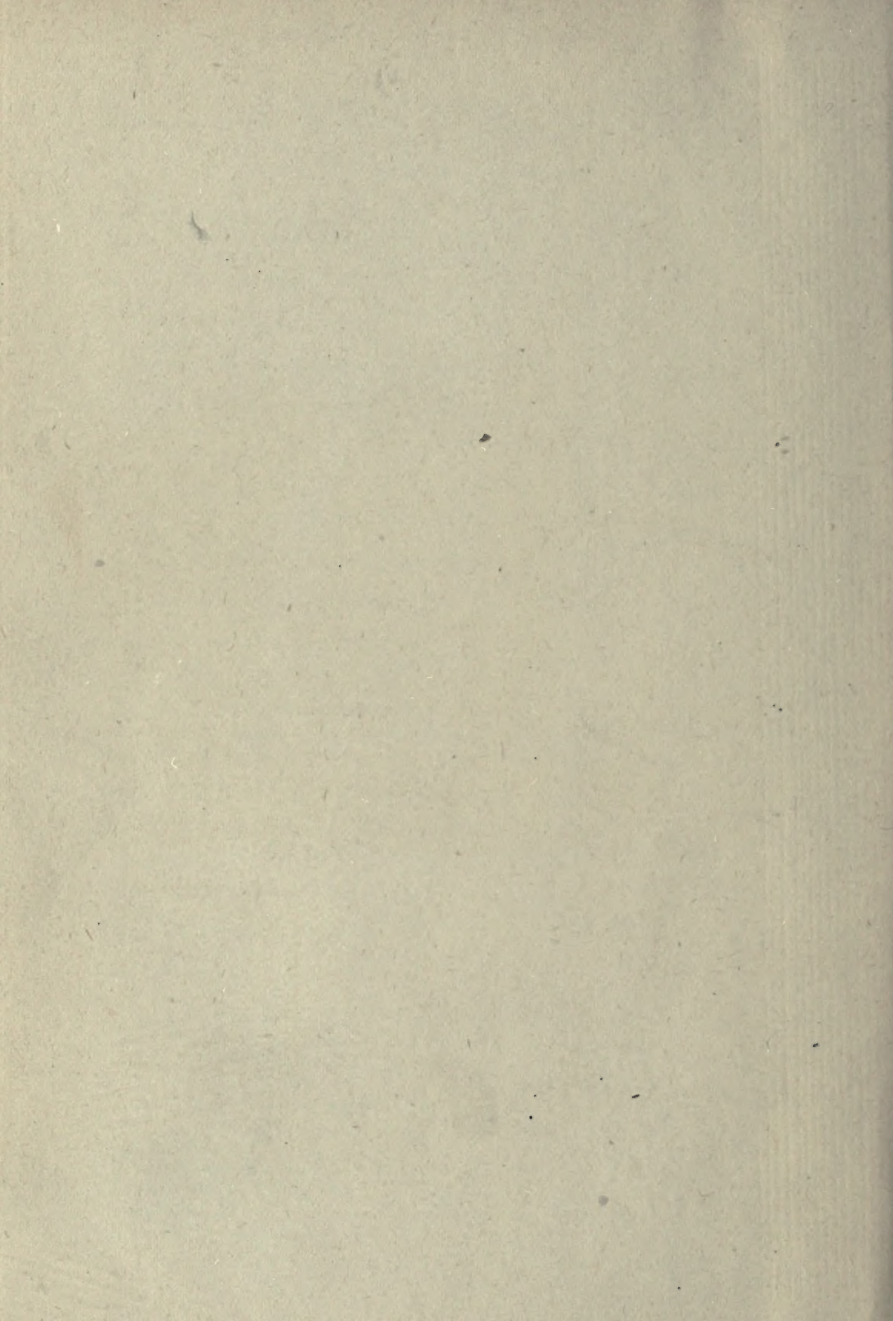
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